TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. VIII No. 7. JULY, 1931. PRICE 6d.

CONTENTS.

	PAGE.
The Palm Products Industry	169
Palm Oil in Nigeria	171
Fusarium Wilt Disease of Sunn Hemp—II	176
West Indian Hurricanes	178
Russian Cotton	185
Sweet Potato Storage Trials	185
Tomaspis or Monecphora	187
West Indian Notes	188
A Solid-Fleshed Tomato	191
Tropical World Notes	192
Sugar Notes	193
Chemical Notes	194
Reviews	195
Plant Breeding Abstracts	195
Books Received	195
Trend of the Markets	196

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 2183.

TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from the various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

THE PALM PRODUCTS INDUSTRY.

WITHIN the last few years it appears as if our important West African palm oil industry is perceptibly losing the pre-eminent position which it has hitherto occupied in the world markets. It is true that exports of palm oil and palm kernels from Nigeria and Sierra Leone have increased and that their palm kernel industry has maintained its supremacy. Little change, however, has been effected so far in the primitive methods employed in the cultivation, collection and preparation of these products and, in spite of repeated warnings, progress towards the improvement of this side of the industry has been extremely slow. In this connection it may be recalled that nearly eight years ago a Committee was appointed by the Colonial Office to consider the best means by which our West African palm products industry might be improved. This Committee, in their report (1), pointed out the growing dangers from a rapidly developing palm oil industry in Sumatra and British Malaya, condemned the crude and wasteful native processes of collection and production, and finally discussed in detail the possibility of, and the necessary legislation for, establishing palm oil mills in our West African possessions. There are various objections to the latter scheme and these were dealt with fully. In 1926, Mr. Ormsby-Gore, reiterated many of the Committee's views but was averse to any system of development which might involve compulsory measures. He thought, however, that some form of Government enterprise might be desirable in Nigeria and Sierra Leone, and advocated the establishment of a large plantation in Nigeria which might be run on a commercial scale with an up-to-date mill of its own. Again, in 1927, the palm oil industry was one of the chief subjects discussed at the West African Agricultural Conference, and much attention was paid to the so called "eastern menace". The only claims, however, that can be made so far with regard to the general improvement of the industry on the West Coast have been some valuable chemical and botanical investigations carried out by the Departments of Agriculture; the erection of three mills, one in the Gold Coast and two in Nigeria; the formulation of a subsidy scheme for the erection of central factories, which has not yet yielded any appreciable results; and, at the principal oil ports, the installation of plant for the handling and shipment of oil in bulk and the provision of tank accommodation on ships for such cargo.

In the meantime, large areas of palms have been planted in Sumatra, which in 1929, exported 35,000 tons of oil or over a quarter of Nigeria's exports of the same product that year. Since 1926 the production of palm oil in Sumatra has nearly trebled. In the Federated Malay States the area under palms has been increased to 30,000 acres and these Colonies are now producing half of Sierra Leone's exports of oil. In the Belgian Congo a British firm has secured a concession to plant up to nearly two million acres of oil palm bearing lands, and at least 15 mills are said to be working. In a minor way the British Cameroons have a number of European plantations of commercial importance which have shown steadily increasing yields in recent years. In all these countries the industry has been carefully organised on a modern plantation and factory scale, and visitors have been generally impressed by the healthiness of the plantations, the size and efficiency of the factories, and the progress made in a comparatively short time. Thus it appears that the palm oil industries of the East and of the Belgian Congo are likely to become of considerable importance. Furthermore, if these countries are able to produce their oil, which is already of a better grade, at a lower price than West African oil, a serious position may arise for British West Africa. The immediate danger may not be great but it cannot be overlooked. Plantations in the East are still young and there are signs that the yields of the trees have shown a tendency to decline after a certain age. This has been due, apparently, to faulty methods of cultivation in the early stages, and to lack of manuring, errors which the Dutch say they will eventually rectify. On the whole competition from the Belgian Congo is more to be feared just now than from the East, while an increased supply of copra from the East Indies and other parts of the world is also a factor which will have to be reckoned with as a competitive element.

Admittedly there are many difficulties in the way of developing an organised plantation and factory industry. Even now the need in our West African Colonies for an industry run on these lines has not been proved although it may, on the surface, appear desirable. The industry is at present entirely in the hands of native farmers whose rights to lands and the produce of their forests must be safeguarded. One of the main problems lies in how to safeguard these rights in the event of concessions being granted to outside interests. So far no really satisfactory solution has been found. No private capital can be risked, however, until this problem is solved. It is obvious that prospective mill owners must be assured at least of a regular supply of fruit, and for this they cannot depend entirely on the native, as has already been proved in the case of the failure, on this account, of a mill in Sierra Leone. Many other concessions, would, in addition, have to be allowed to mill owners before a factory industry could be adequately safeguarded. The successful development of small holdings with certain obligations on the part of the native to supply fruit to the mills appears doubtful unless, of course, the natives become sufficiently educated to appreciate the benefits that would result from such a development. And yet the future of industries where chemical processes are involved appears to be in the production of uniformly graded raw materials. As the West Coast at present cannot supply the large quantities of clean palm oil of uniform grade that the trade demands, the time has come for a reconsideration of the problems in relation to the establishment of a factory system in Nigeria and Sierra Leone. If the mill system is impracticable a solution may be found in the invention of a cheap and satisfactory hand machine which the native could use to deal with the product. This would have, however, to be worked on a very large scale if any important economic results were to be achieved. In this connection the Nigerian Department of Agriculture is carrying out investigations which may in the end prove the salvation of the industry. The Sierra Leone Department of Agriculture, on the other hand, is carrying out a test of oil palm plantations, the progress of which will be watched with interest. If the present systems of production are maintained it remains to be seen whether "a low grade fruit and inefficient methods of extraction with no overhead charges can exist in competition with high grade fruit, and very efficient methods with high overhead charges" (2). The palm products industry in our West African Colonies, appears to be in need of further co-ordination and consolidation. Additional efforts should be made, if possible, to work and develop West Africa's natural oil palm forests on scientific lines and above all to teach the natives to improve the present condition of the existing trees so that larger yields of fruit may be obtained at less cost of labour and transport. Full advantage should also be taken of Empire and other markets which are more easily accessible from the West Coast of Africa than by the East Indies. It is only by improving the industry in these directions that the wealth and prosperity of the Colonies concerned can be assured.

(1) *Palm Oil and Palm Kernels.*—Report of a Committee appointed by the Secretary of State for the Colonies, September, 1923, to consider the best means of securing improved and increased production. (*Colonial Report* No. 10), price, 9*d*. net.

(2) Proceedings of the First West African Agricultural Conference, March, 1927.

MYCOLOGICAL SERIES No. 4.

This Memoir (price 2*s*.) which has just been published can be obtained on application to the Editor, Imperial College of Tropical Agriculture, Trinidad, B.W.I. :—It is entitled "Macrophomina Phaseoli (Maub) Ashby in Trinidad" and is by J. West, B.S.A., A.I.C.T.A., and R. W. Stuckey, M.A., B.S.A., A.I.C.T.A.

PALM OIL IN NIGERIA.

Investigations into the Production of Palm Oil in Nigeria.

By D. Manlove.

The annual rainfall in Nigeria is at its maximum at the coast, and falls off fairly uniformly as one proceeds inland. The coastal rainfall also shows an increase from West to East, the maximum figures for the country, not including the mountainous Cameroons territory, being recorded east of Calabar. The Oil Palm, which does not usually thrive where the annual rainfall falls below 50 to 60 inches, is therefore found to flourish in Nigeria in a strip (or 'belt' as it is commonly called) of land bounded on the south side by the swampy coastal land, and on the north by the line of minimum rainfall. This belt thus widens from about 50 to 60 miles at the west end to about 100 miles at the east end. The Oil Palm favours a well drained soil, and does not usually grow right to the coast, which as a rule is low-lying and swampy in Nigeria. The two factors of rainfall and soil combine to produce the most favourable conditions between the Niger delta and the Cross river: in the mandated Cameroons territory the soil is mainly volcanic and a poorer type of fruit is found there.

Numerous classifications have been made of Nigerian Palm fruit: the principal varieties are:—

1. Thick-shelled Ordinary .. Native name Okporo
2. Thin-shelled Ordinary .. do. Osok Eyop
3. Green-fruited type
4. A thin-shelled form of this } do. Afia Oku
5. Mantled type (has a fleshy, oil-containing perianth)
6. A thin-shelled form of this } do. Ayara Mbana

The first type is so enormously predominant that for practical purposes the others are at present chiefly of botanical interest.

Composition of Palm Fruit.

The fruit consists of a nut surrounded by a fleshy, oil-containing layer usually called (incorrectly) 'pericarp.' Analyses of the ripe pericarp show only slight variation either with type of fruit or with locality: the richness or otherwise of a fruit is dependent primarily on variations in the proportion of pericarp. The proportion of pericarp in the thick-shelled types I and III varies between 35 and 50 per cent. of the ripe fruit, and in the thin-shelled types II and IV between 70 and 80 per cent.

Variations in the proportion of pericarp to fruit are found also with:—

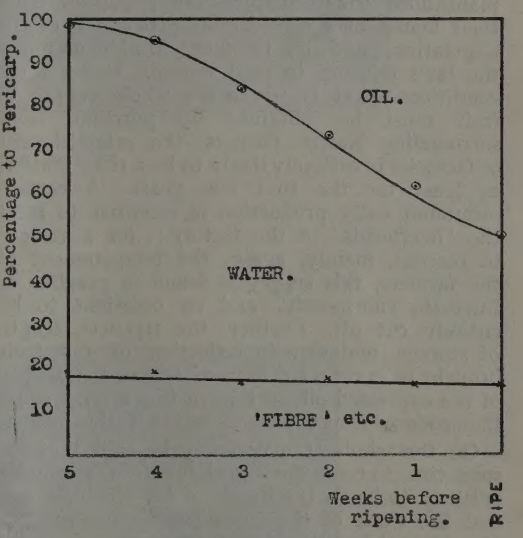
a. Climate and soil conditions as has been mentioned,
b. Season, and
c. Age of tree.

The period of maximum bunch-yield is during three or four months following the early rains: a noticeable drop occurs from September to December, less marked where the rainfall is high. To some extent the richness of the fruit follows the productivity, *i.e.*, is greatest at the most prolific period. Young trees, up to ten years, yield a somewhat poorer fruit than fully developed trees.

Analysis of Pericarp.

The composition of an average pericarp on ripening is shown in the diagram. Under very favourable conditions the oil content is slightly higher. It will be seen that an average ripe pericarp is composed of oil 50 per cent., water 33 per cent., fibre, &c., 17 per cent. The structure of the fibre will be discussed later.

Ripening of Palm Fruit Pericarp. (Nigeria)



Nigerian Palm Oil Industry.

With the exception of certain areas, mainly coastal, in the mandated territory of the Cameroons, the production of Palm Oil in Nigeria is almost exclusively in the hands of Native farmers, and either by the original Native methods or by a modification of these introduced to meet the requirements of the exporter. Despite the rapid growth both of this export market and of transport facilities, the farmers have made on their own little or no attempt to organise their production: such common sense matters as the planting up of new and readily accessible land, are, except where the efforts of this Department are beginning to bear fruit, still neglected: but for the delegation of the rougher work to the men, and the rest to the women, there is little organisation or system. The industry in fact remains what it must have been from the remote past, a 'kitchen' process designed primarily to feed the family or village,

which may or may not produce a surplus for sale in the market. The only advance, if advance it can be called, is the evolution of the Hard Oil method which produces oil of high acidity intended only for export. This will be referred to later.

It is necessary here to refer briefly to the vexed question of the establishment of factories in Nigeria for the extraction of Palm Oil by machinery. Such factories, drawing almost their entire supply of fruit from privately owned plantations, are in existence in the ex-German territory of the Cameroons, being run in most cases by their original German owners. These have been studied in some detail by this Department, as have also some of the factories of the British-owned 'Huileries du Congo Belge.' In Nigeria, however, the Oil Palm 'belt' previously referred to comprises some of the most thickly populated districts in the country: the acquirement of land in this area for private plantations would involve the expulsion from their homes of a considerable proportion of the population, and is, in fact, forbidden under the laws relating to land tenure. Under these conditions—that is, where the whole supply of fruit must be obtained by purchase from surrounding Native farmers—the establishment of factories is certainly likely to be a risky matter, at least for the first few years. A certain minimum daily production is essential to meet the 'overheads' of the factory: for a variety of reasons, mainly, again, the temperament of the farmers, this supply is found in practice to fluctuate enormously, and on occasions to be entirely cut off. Further, the ripeness, length of storage, and care in collection of the fruit brought in is reflected immediately in the acidity of the expressed oil, so that in this respect again the producer is at the mercy of the Native farmer.

On the whole it may fairly be said that for some time to come the Nigerian Palm Oil industry is likely to be in the hands of the small-farmer, and the work of the Chemical Section of this Department has therefore been concerned largely with the advancement of a small-scale industry. It must not be forgotten that in spite of its technical inefficiency such a small-scale industry may well prove to be economically more sound to the country: it is unaffected by such matters as running costs, interest on capital, or depreciation of stock, nor is it burdened with heavy labour costs.

Structure of Pericarp 'Fibre.'

In the extraction of oil from a pulpy material such as the pericarp of Palm Fruit, particular difficulty may arise from the softness of the cell tissue. The dry, oil-free 'fibre', as has been mentioned, constitutes some 17 per cent. of the pericarp. This is made up of :—water-soluble materials, two per cent., coarse fibres ten per cent., true pulp tissue five per cent. The coarse fibres are one to two inches long, some 80 to 100 of them being joined together at the base of the fruit, and providing a skeleton for the support of the pulp. The pulp is composed of large, thin-walled cells containing most of the oil. When the fruit is mashed or pounded, the coarse fibres, which are hard and woody, are little affected, but the pulp becomes a sludge, which may be seen under the microscope to consist of portions of cells or groups of a few cells. A considerable proportion of the oil is at the same time liberated, some of which adheres mechanically to the coarse fibres. The majority is suspended in a finely divided state in the mash of pulp cells. These pulp cells, if dried, have the power of absorbing large quantities either of water or of oil to form thick sludges, but water is preferentially absorbed, so that if shaken with excess of a mixture of oil and water, the pulp cells are found to be suspended in the water layer. If an excess of water (so that the viscosity of this suspension is not great) is added to mashed pericarp, the liberated oil rises to the surface, while the pulp cells and any oil still contained in them, remain suspended in the water. This is the principle of most Native extraction processes.

Native 'Soft Oil' Method.

The Native extraction processes have been described at length in the Bulletins of this Department, and these should be consulted for a detailed account. They are the Soft and Hard Oil processes, or varieties of these, so-called in reference to the acidity of the product. Oil extracted by the Soft Oil method has an acidity usually varying between four and ten per cent. expressed as Palmitic Acid, and is used to an enormous extent in Nigeria for edible purposes. The stages in this process are as follows :—

1. The bunches are cut and collected.

2. The short bracts, or clusters of fruit, are chopped from the main bunch stalk (fig. 1).

3. After a period of storage, usually two or three days, the fruits are picked by hand from these bracts. The storage is necessary to loosen the fruits: alternatively the bunches may be stored prior to chopping.

4. The fruits are kept in gently boiling water in earthenware pots for about 12 hours, then allowed to cool. The pots are supported on three stones as a grate, or three pots may be grouped round the fire.

5. The cold fruits are mashed with heavy wooden pestles in wooden mashing pots. This process is the most vital in determining the yield of oil, and is very thoroughly performed. (fig 3.)

6. The extraction is carried out either in sloping wooden canoes capable of holding about half a ton of fruit, or in mud pits in shape similar to the one shown in fig. 4. The cold, mashed fruit is piled in the upper half of the canoe or pit and the lower half filled with cold water to an extent which must give a weight ratio water : fruit at least 2 : 1. Two women usually

PALM OIL IN NIGERIA.

FIG. 1.
Chopping fruit from bunches.

FIG. 2.
Picking fruit from bracts or clusters.

PALM OIL IN NIGERIA.

FIG. 3.
Mashing fruit (soft oil process).

FIG. 4.
Oil extraction (soft oil process).

get into the lower half, and gradually transfer the fruit to the water with constant stirring with their feet. Oil continues to rise to the surface as the stirring proceeds, and is removed in the form of a yellow scum or emulsion containing a considerable quantity of water. Afterwards quantities of water are repeatedly lifted from the pit and allowed to splash back. The 'coarse' fibres are then removed from the pit with the aid of a basket to act as a sieve (they are sometimes given a further mashing and extraction) and afterwards the nuts.

7. The oil-water emulsion obtained is warmed, and the oil easily separated by skimming.

8. Traces of water still in the oil are boiled off.

It will be seen that the extraction force in this process is merely the difference between the specific gravity of Palm Oil (0.90) and that of the still oily pulp (c. 1.05), aided by the latter's preferential absorption of water. The quantity of water which must be used is determined by the viscosity of the resulting pulp suspension which must not, of course, be great enough to prevent the oil from rising. Thus the water and suspended pulp have to be thrown away after each extraction, whereby results the principal loss of oil, and the labour of fetching more water, sometimes from considerable distances. The splashing is in order to liberate suspended oil. After a reasonably thorough extraction, analysis of the residues shows:—

	Mechanically held by Coarse Fibres.	In suspended Pulp.	Total.
Per cent. of total available oil	15	20	35

The efficiency of the process is thus of the order of 65 per cent. Carelessness or lack of skill account for the lower yields so often observed.

Hydrolysis.

It has been mentioned that the acidity of oil produced by the Soft Oil process usually varies between four and ten per cent. this acidity is found to depend on the length of storage of the fruit before cooking, the ripeness or over-ripeness of the fruit, and the extent of bruising which has resulted from the fall of the bunch from the tree. Thus a ripe fruit removed from a bunch and kept under boiling water for a few minutes yields an oil of F.F.A. 0.2 per cent: further, the acidity of this oil, if kept out of contact with impurities, remains fairly constant on storage, rising by about one per cent. per year. The F.F.A. of the oil increases rapidly with over-ripeness of the fruit becoming five to ten per cent. when the over-ripeness is only slight, and as much as 30 per cent. when it is pronounced. An oil, moreover, which is extracted in the cold from a fruit which has undergone no cooking process, is found also to exhibit a rapidly increasing acidity. These facts clearly point to the existence in the raw fruit of a fat-splitting enzyme which is inactive until the cell structure is in some way broken down and which is destroyed at a temperature of 100°C. The actual minimum temperature which is found to destroy the activity of the enzyme is in the neighbourhood of 55°C. On account of the ease and simplicity with which this method of destruction can be applied it has not been thought worth while to devote much attention to others: some experiments made by A. C. Barnes (*loc. cit.*) indicate an inhibiting action in dilute solutions of sodium carbonate, sulphuric acid, sodium sulphite, &c.

Thus the quality of Palm Oil, as regards acidity, is determined fundamentally by the period which is allowed to elapse between any bruising or softening of the ripe fruit and the destruction of the enzyme, that is to say, in terms of extraction procedure, between collection and boiling. These things being equal, the effect of the method of extraction is comparatively minor.

The 'Hard Oil' Process.

If the prevention of the hydrolysis of the oil ceases to be a matter of prime importance, it is possible to introduce modifications into the Soft Oil method which considerably economise both labour and fuel. In the first place operations two and three, the cutting and picking of the fruit from the bunches can be eliminated by simply storing the bunches in heaps for periods of about six days. They have then merely to be shaken and tapped in order to release all the fruit. The fruit is then in a semi-fermented state, and, if allowed to ferment slightly more by moistening and keeping in heaps, is found to be soft enough for mashing without the necessity for the boiling process five. If the mashed and fermenting fruit is now piled in a heap on a sloping board sprinkled with a little water, and a channel made underneath, a considerable proportion of the contained oil is liberated by the heat of further fermentation and flows out clear and free from water. More can be washed out from the mash with a little hot water: This will have to be skimmed from wash water, but the oil obtained up to this stage is usually given no further treatment. A flotation process (with cold water) exactly similar to the Soft Oil procedure, will finally separate the pulp and nuts, and at the same time give a small residual yield of oil. In practice the fruit is allowed to ferment in the lower end of a sloping wooden canoe and gradually transferred to the upper end during mashing (usually a treading process).

The efficiency of which this method is capable is of the same order as that of the Soft Oil method, that is, approximately 65 per cent. but in practice, on account of the less labour involved, this degree of efficiency is usually more closely approached in Hard Oil production.

The F.F.A. of oils produced by the Hard Oil process may vary from 20 to 60 per cent. (as Palmitic Acid). It will be seen that the majority

of the oil is subjected to no heating process other than that of fermentation, and therefore contains an active, fat-splitting enzyme when shipped. Hydrolysis will therefore proceed at a gradually decreasing rate as the action of the enzyme is slowed up under increasing concentration of fatty acids. To a large and growing extent, however, Nigerian oils now pass through 'Bulking Stations' before export, where they are graded and bulked according to F.F.A.: during this process they are also *steam-heated* and cleaned by decantation from condensed water, so that the exporter is able to rely on the oil maintaining its 'Grade' during the voyage to Europe.

Economic Aspect of Native Processes.

Of the two (principal) Native methods, therefore, the fermentation process is the more economical of labour and fuel. It is practised largely in coastal areas where creeks permit of easy water transport. To account for the great extent to which the Soft Oil process is used it must be remembered that only a portion of the country's production of oil is shown by export statistics. A larger proportion, probably twice as much, is used or sold in Nigeria for edible purposes, and for such Hard Oil is naturally unsuitable. On the northern side of the 'belt,' where transport to the coast is expensive, the internal market is usually the more lucrative.

Palm Oil is usually sold in England on a basis of F.F.A. A variety of systems of premia and rebates are in existence, but these are as a rule so adjusted as to make Soft Oils rather more expensive than 'Hards.' One of the principal users of Palm Oil, the soapmaker, who uses only the fatty acids, will therefore buy 'hards' as a rule, unless the value of the extra glycerol obtainable on the saponification of more neutral oils at least compensates him for the extra premium. This has rarely been the case since the dwindling of the market for glycerol after the War. There is a fairly considerable demand for Soft Oils as such, notably in the tin-plating industry, but Palm Oil has not hitherto been found particularly suitable for use in edible fats, and thus the greatest market for neutral oils is denied to it. Under these circumstances it is clearly impossible for the buyer to pay the Native producers a high premium for Soft Oil. The most he can do is to hand on a reasonable portion of the premium he himself may receive under the selling agreement already referred to.

Improvement of Native Methods.

The preceding paragraph was intended to show that any improvement on present methods which is to be acceptable to Native farmers must primarily show a greater ratio of yield to total labour, as a higher quality product will not at present command a proportionately higher price.

Starting with fresh, ripe fruit a preliminary softening process—boiling, steaming, or fermentation if Hard Oil is to be made—is essential and offers no particular difficulty. (The fragile Native earthenware pots are being substituted by metal half-drums, two of which are made by cutting transversely used lubricating-oil drums, since these are available in fairly large quantities.) The question which then arises is as to the feasibility of modifying the pit or canoe extraction processes, if necessary with the aid of very simple machinery. Space does not permit a description of the work which has been done in attempting to combine the better features of Native methods into a process which shall still be independent of European machinery.

It must suffice to say that flotation methods have so far been found to be limited to an efficiency at least of the same order as has been mentioned: to improve on this requires the application of a more powerful extraction principle.

Use of Machinery by Natives.

The essential qualities of a machine to be used by a Native farmer are, of course, strength, simplicity, and cheapness. The number of working parts, and the possibilities of misuse must be reduced to a minimum, and the farmer has then to be carefully instructed even in such matters as the necessity for lubrication. On these grounds even the simplest centrifugal machinery was felt to be at a grave disadvantage in comparison with hand-operated presses, and attention has therefore mainly been devoted to the latter. It must, however, be mentioned at this stage that, from other points of view, a small centrifugal extractor would have many advantages, not the least of which is that the difficulty of extracting fruits of low pulp content would not arise. This, as will be described, is unfortunately far from being the case with press extraction.

Hand Presses.

The hand-screw press (fig. 6) has been found satisfactory in design. The cage has a capacity of one cubic foot and is either an open cylinder standing on a perforated base plate, or carries a false bottom on an internal flange.

With two men operators a pressure of about 5 cwt. per square inch can be obtained and an extraction efficiency when working with pericarp only, of 80 to 85 per cent. Unfortunately the minimum price at which it appears to be possible to construct this press in mild steel is about £15—considerably more than will give the native producer a reasonably quick return for his money. A Lever-type press (fig. 7), can be made for about £5, but is cumbersome in operation and lacks the necessary mechanical advantage. Designs of a screw-press are therefore being tried in which the steel framework is replaced by a wooden one, only the screw-shaft and bush being retained in metal. The hard West African Iroko wood is very suitable, and, though not of course as durable as steel, is at least readily replaceable (fig. 8).

Press Process.

A more serious difficulty is encountered in the constitution of the fruit which is to be pressed. The pulp to fruit ratio of Nigerian fruit, as has

been previously mentioned, usually varies in ripe fruit of the 'ordinary' type from 35 to 48 per cent. by weight, according to season, locality, and other conditions. Even at the maximum this proportion by weight corresponds to a volume ratio which does not permit of the 'pore space' of the nuts being filled by the compressed pulp. (The term 'pore space' is used for want of a better to denote the volume proportion of air space in a quantity of tightly packed nuts.) The pore space of tightly packed nuts of the Nigerian thick-shelled ('ordinary') type has been found in a series of experiments to be approximately 38 per cent., and this space is not completely filled by pericarp under the maximum working pressure of the hand-screw presses (about 3 to 5 cwt. per square inch) until the original pericarp content of the fruit approaches 55 per cent. by weight, assuming an average pericarp. It follows that Nigerian fruit as such, even under the optimum conditions, can never be thoroughly extracted by pressing whatever pressure be employed, unless

(*a*) a fair proportion of the rarer thin-shelled varieties, containing 75 per cent. of pericarp, happen to be included in the harvesting,
(*b*) nuts are broken, or
(*c*) definite steps are taken to obviate this difficulty.

In fact, if the fruits are kept fairly dry during mashing, it is occasionally found that no oil whatever can be expressed directly. The only conceivable steps which can be taken under (*c*) are either the separation of all or some of the nuts, or the addition of pericarp until the necessary proportion is reached. The latter method can be conveniently carried out by the re-addition of already pressed and separated fibre, and gives satisfactory results, but on a small scale, this is a tedious and laborious process. Separation of nuts and pericarp can be effected by any of the three following means :—

A.—A Mechanical 'Depericarper.'

As yet a thoroughly satisfactory machine has not been found. It is felt that the psychological factor is of paramount importance in connection with any proposal to introduce a second machine, however cheap and simply designed. Unfortunately it is very difficult, if not impossible to produce a depericarper which, from an African's point of view, has either of these qualities, as rapid wearing of working parts can hardly be avoided unless these are made of steel.

B.—Hand Picking.

This method of separation has had to be used to a great extent in work with hand-presses, but it introduces an element of tedious and protracted labour which cannot be ignored. It is also no easy matter to make it even as much as 90 per cent. efficient. It was hoped that the difficulty would be simply solved by the use of some such accessory apparatus as wooden screens, wire sieves, &c., but this has not been realised. The ideal method of dry separation by hand has yet to be found.

C.—Washing with Water.

The rapidity and completeness with which the pericarp can be separated from the nut by washing, and the fact that Native farmers are accustomed to the practice of this method, makes it disappointing that when so separated, the pericarp is, from the point of view of extraction by pressing, in an almost unmanageable state. Reference to earlier paragraphs describing the behaviour of pericarp in water will explain this: it will be recollected that, while the coarse fibre portion can readily be separated by hand or with a coarse sieve, the majority of the oil is retained in intimate mixture with the pulp cells which are suspended in the wash water. This pulp may be recovered, it is true, by filtration through sacking, grass mats, or even the already separated coarse fibres, but it is then obtained in the form of a thick sludge which requires drying and readmixture with the coarse fibres before pressing. The pressing of palm fruit pericarp under these conditions becomes in effect a process of filter-pressing, the coarse fibres acting as filter to the broken pulp cells which would otherwise be forced out unchanged.

Moisture Content of Pericarp to be pressed.

In this connection, if the moisture content of the pericarp which it is intended to press greatly exceeds 30 per cent., the volume and consistency of the 'pulp' portion become too much for the coarse fibres to retain, and at higher pressures the sludge is forced out of the press cage. The extent to which this occurrence, which is one of the bugbears of palm fruit pressing, takes place depends also largely on the thoroughness of the mashing process. On the other hand it has to be remembered that a considerable amount of liquid is still retained by the pericarp under the maximum pressure, and that excessive drying will result in an undue proportion of this being oil.

Summary.

It may be said that the difficulties of introducing small-scale press extraction methods into Nigeria lie less in the designing of a suitable machine than in the processing which must inevitably accompany its use with fruits of relatively low pericarp content. By the use of centrifugal machinery most of this could, it is true, be avoided, but such advanced methods must remain beyond the reach of the African farmer until he has acquired a rudimentary mechanical understanding, and, equally important, learnt something of the meaning and advantages of co-operation.

Demonstrations which have been made of the steel presses have met with a satisfactory response, though carried on under a considerable handicap. There is every reason to hope that, when experimental work is complete, hand press extraction methods will be widely adopted, and perhaps pave the way to a desire for still better things.

References.

1. *Bulletins of the Agricultural Department of Nigeria*, 1922 to 1930.
2. Barnes, A. C. *Chemical Investigations into the Products of the Oil Palm.*

FUSARIUM WILT DISEASE OF SUNN HEMP—II.

By C. A. Thorold, B.A., A.I.C.T.A.

Introduction.

In continuation of observations by A. K. Briant and E. B. Martyn (1) in 1927-28, and by R. Leach and J. Wright (2) in 1928-29 counts were made in 1929-30 of the percentage of infection of Sunn Hemp by Fusarium wilt disease, in the plot area on the South side of Field C.

History of the Plot Area.

In 1927 the area was divided into 25 plots, five of which were occupied by Sunn Hemp (this is referred to below as the plot arrangement in 1927). Fusarium wilt disease occurred and the average loss was 25 per cent. In July, 1928, half of the area was limed at the rate of ten tons to the acre. The whole area was divided by R. Leach and J. Wright (2) into 48 plots in a chessboard fashion, receiving different manurial treatments. Each plot was divided into two, one half of which was sown with Pigeon Pea, the other with Sunn Hemp (this is referred to below as the plot arrangement in 1928).

In June, 1929, the present writer took locatory measurements of the pegs marking the boundary of the plot area under consideration, thereby enabling the same points to be plotted out in October, 1929. In the interval June to October, 1929, the whole of Field C had been under a cover crop of Bengal Beans, which were cut and ploughed in, previous to the replotting of the area.

Over the plot area (plotted out as in 1928) 26⅔ lb. of Sunn Hemp seed were broadcasted in November, 1930 (equivalent to 36 lb. to the acre). During the growth of the crop it became very obvious that in the case of practically every plot, the half which was occupied by Pigeon Pea in the previous year was carrying a good stand of Sunn Hemp, whilst the corresponding half of the same plot which was occupied by Sunn Hemp in the previons year showed the effects of Fusarium wilt to varying degrees. (Figs. 1, 2.) Certain factors, however, slightly modified what was otherwise a perfectly 'diagrammatic' representation of the history of the plot area in regard to Sunn Hemp wilt.

(1) In those plots on or adjacent to the Sunn Hemp plots of Briant and Martyn in 1927-28, the infection was so severe as to spread into, as well as being still present in, the position occupied by Pigeon Pea in the previous year. Quoting Leach and Wright (2), "Nearly all the plants within the Sunn Hemp areas" (that is, the 1927-28 Sunn Hemp areas) "succumbed to the disease." In such plots there was only a small positive difference in percentage infection in Sunn Hemp and Pigeon Pea areas.

(2) As mentioned by Leach and Wright, the plot area was subject to severe waterlogging during the wet season, and this as well as wilts in the seedling stage (*Colletotrichum* and *Fusarium* spp.) resulted in some of the plots having a poor stand of Sunn Hemp, so that the 'diagrammatic' effect above mentioned, was not so apparent. In February, 1930, when the crop had matured, the Sunn Hemp was harvested in the following manner. Through the long axis of the plot area (E & W), the centre of each plot was marked and lines so obtained running East and West, divided each plot into the 1928 Pigeon Pea and Sunn Hemp halves. The Sunn Hemp was then cut and bundles made up of diseased and healthy stems (the difference is sufficiently marked externally and by the leaflessness of a wilted plant). In each plot there might be four bundles, one bundle each of healthy and diseased stems in each half. Counts were made of the number of stems in these bundles, and thereby the percentage of wilt in each half of every plot obtained.

Apparent Immunity of Cotton to the Fusarium Causing Wilt of Sunn Hemp.

Both Asiatic and Upland types of cotton were grown on the Northern half of Field C, adjacent to the Sunn Hemp plot area, and in no case was there any incidence of wilt of cotton attributable to *Fusarium* sp. Sunn Hemp has also been known to be affected by this wilt in other plots on the farm and a crop of cotton grown on same land immediately following Sunn Hemp showed no evidence of wilt disease.

Percentage of Wilted Plants (to the nearest whole number) in each half of every Plot.

Sunn Hemp 1928.	*Pigeon Pea.* 1928.	*Difference.*	*Sunn Hemp* 1928.	*Pigeon Pea* 1928.	*Difference.*
48	47	1	12	11	1
81	46	35	80	15	65
72	47	25	45	27	18
54	17	37	72	54	18
63	26	37	71	31	40
70	19	51	44	0	44
60	48	12	90	67	23
68	64	4	82	42	40
82	71	11	88	43	45
88	59	29	82	61	21
86	58	28	92	44	48
73	32	41	83	56	27
85	77	8	72	31	41
46	31	15	77	27	50
94	55	39	63	23	40
92	14	78	59	19	40
51	12	39	22	19	3
67	24	43	25	6	19
92	88	4	89	62	27
100	41	59	95	70	25
100	79	21	75	67	8
96	60	36	94	24	70
83	49	34	93	52	41
69	42	27	93	39	54

Mean % difference=31.7
Standard error of the Mean % difference= 2.482
Standard error of a single difference =17.2
Difference=31.7=12.77.
Standard error 2.482.

Percentage of Wilt in Limed and Unlimed Plots.

Percentage of Wilted Plants (to the nearest whole number) in the Limed Area.	*Percentage of Wilted Plants (to the nearest whole number) in the Unlimed Area.*
45	40
71	34
73	24
75	55
67	60
53	48
53	51
64	24
72	35
81	59
60	39
90	79
70	26
63	46
72	27
67	35
57	25
77	11
54	16
61	19
50	45
69	42
82	49
69	41
Mean % 66.5	39.6
Standard Error of the Mean % 2.141	3.328

Difference between the Means = 26.9

Standard error of the difference between the Means = 3.96

Difference = 26.9 = 6.8
Standard error 3.96.

During the growth of the crop it was noticeable that there was on the whole a taller and thicker growth of Sunn Hemp in the East (Limed) portion of the plot area. This was confirmed when counts were made of the stems in the bundles (*see* above).

In May, 1930, 12 samples of soil were taken on the plot area, six being from the limed half and six from the unlimed half. Determinations of the pH values of these samples were carried out by the Chemistry Department. The normal pH of the samples from the limed half ranged from 7.27 to 7.68, averaging 7.52. In the unlimed half the normal pH of the samples varied from 5.60 to 6.38, averaging 6.04.

There is a significant difference between the percentages of wilt in the limed and unlimed areas. The greater percentage of wilt being in the limed area.

Leach and Wright (Part I) found that in culture the greatest growth of the Fusarium occurred with an initial pH value of the medium of 6.0, and was only slightly less at pH 7.0. Growth at pH 8.0 was less than that at pH 5.0.

It is suggested that the greater percentage of wilt on the limed part of the plot in the present case may have been due to the denser stand of Sunn Hemp, the roots being in greater proximity thereby making the spread of the fungus in the soil easier.

In 1929-30 there was no appreciable difference in the percentage of wilt on the various plots, which had received different manurial treatments in 1928 (2).

Summary and Conclusions.

(1) The Fusarium species, probably a biologic strain of *F. vasinfectum* causing wilt disease of Sunn Hemp does not infect cotton, Cow Pea, Bengal Bean, Sword Bean or Pigeon Pea.

(2) The fungus does not spread in the soil when an unsusceptible crop is grown. It has been shown that a crop such as Pigeon Pea, will in this way prevent the spread of the Fusarium in the soil.

(3) Whether a long rotation would actually decrease the 'concentration' or virility of the fungus in the soil, is not known. A rotation of over a year (16 months) does not have this effect.

(4) Leach and Wright found that manurial treatment does not affect the incidence of wilt, but liming was probably beneficial. In the present case both a denser growth of Sunn Hemp and a greater percentage of wilt were observed on the alkaline soil of the limed area, compared with the growth of the crop and incidence of wilt on the unlimed area with an acid soil. The greater percentage of wilt might then be due to easier spread of the fungus, from more intimate root contact.

(5) In the case of Sunn Hemp wilt, the rate and distance of spread radially from a centre of infection, is proportional to the intensity of infection at that centre, and varies as the degree of infection of the soil at that centre.

References.

(1) Briant, A. K. and Martyn, E. B. Diseases of Cover Crops. *Tropical Agriculture*, Vol. VI, No. 9.

(2) Wright, J. and Leach, R. Fusarium Wilt Disease of Sunn Hemp—I. *Tropical Agriculture*, Vol. VIII, No. 6.

NOTICE.

ANY reader wishing to dispose of any of the following numbers of *Tropical Agriculture* is requested to communicate with the Editor, Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

Vol. I, Nos. 1, 5, 6, 9.

Vol. II, Nos. 1, 2, 3, 4, 8, 10, 12.

Vol. III, No. 1.

Vol. IV, Nos. 1, 2.

Vol. V, Nos. 2, 3.

WEST INDIAN HURRICANES.

By C. C. Skeete, B.A.,

Assistant Director, Department of Science and Agriculture, Barbados.

Section I.—Introduction.

Atmospheric disturbances of a more or less violent nature, known as "storms" occur in almost all parts of the world, but the most violent types are mainly confined to tropical and subtropical regions. The storms of the tropics, although similar in all important respects, are known by different names in different parts of the world. They are called "cyclones" in the Indian Ocean, "typhoons" in the Pacific, and "hurricanes" in the West Indies or Caribbean area. The name "cyclone," however, may be applied to any of these tropical storms.

In this article an endeavour is made to give a brief and as simple a description as possible of the various aspects of the subject of West Indian hurricanes, including their origin, movement and physical features, in order to enable residents in the West Indies to gain a better knowledge of their most prominent characteristics.

These storms or vast atmospheric whirls, formed as the result of definite conditions, are confined to well-defined areas and are governed by definite laws. They occur within definite seasons of the year, and by the use of modern rapid communication, their position and intensity can be fairly readily determined while still at a distance. In the absence, however, of information communicated from an observer actually within the yet distant storm area, it is possible to observe the approach of a hurricane by certain definite indications in the condition of the weather, clouds and the sea, many hours—sometimes 36 hours—before the arrival of the dangerous zone of the hurricane.

Every year the weather at some or nearly all of the West Indian Islands is influenced to a slight extent, during the hurricane season, often generally unobserved, on one or more occasions by the passage of a distant hurricane or of disturbances of varying intensity at varying distances. In such circumstances certain phases in the approach of a hurricane may be observed or the regular changes in wind direction of a cyclonic storm may be experienced at low wind velocities. It is possible for the careful observer to distinguish between the approach or passage of a severe hurricane and that of a mild and unimportant cyclonic disturbance.

Section II—Nature of West Indian Hurricanes.

Sufficient evidence has not yet been accumulated to warrant a definite pronouncement as to the nature of a tropical cyclone, but such facts as have been recorded by observation support the proposition that the phenomenon may be ascribed to a column of rotating air carried along in the main current of air in the region of its formation.

A hurricane may therefore be considered to be a vast atmospheric whirl, a mass of air revolving around a fairly definite central area; the whole system is approximately circular and is dynamically persistent for days or weeks, with a motion of translation determined by the wider currents of the atmosphere(1). For descriptive purposes the area of the hurricane is usually divided into front and rear and right and left sections, and thus into four quadrants, right front, right rear, left front, left rear: the front of the hurricane being on the side of progressive movement. The system thus indicated may be considered to have a centre, but its properties are not generally arranged symmetrically with regard to it (1). Isobars may be arranged in closed curves, but temperature, wind velocity and humidity show no sign of symmetrical distribution with regard to the centre or area of minimum pressure. (*See* fig. 1.)

The storms of the West Indies range from small local cyclonic disturbances to great devastating hurricanes: the former often represent early stages in the development of the latter. The typical hurricane covers a more or less circular area of about 500 or 600 miles in diameter, moving at the rate of 10 to 16 miles an hour in a Westerly or North-westerly direction across the Caribbean. (*See* fig. 2.) Hurricanes, however, vary in size, ranging when fully developed from 200 to 800 miles in diameter during their passage through the West Indies: they usually increase in diameter, but diminish in intensity on reaching higher latitudes.

The revolving motion of the atmosphere of a West Indian hurricane is in an anti-clockwise manner around in the centre, the pressure of the atmosphere falling from about 30 inches of mercury on the circumference to 28 or even 27.5 inches at the centre. The winds in a hurricane, however, do not blow in a uniform spiral inward movement around the centre: their directions depart from the true circular movement and vary somewhat within the various quadrants according to the distance from the centre. In the right rear quadrant the winds blow in the same general direction as the motion of translation of the hurricane (2) and extend forward into the rear of the right front quadrant. In the right front quadrant the winds tend to blow across the line of advance of the hurricane, and after crossing the line of advance into the left front quadrant they blow around the centre and through the left rear quadrant where they again take up a course nearly across the line of advance.

In the large West Indian hurricanes the velocity of the wind, their most destructive characteristic, increases to about 150 miles an hour, with gusts, particularly in the right front quadrant of 175 and even 200 miles an hour. Cline (2) states: "The wind velocities are much greater in the right half of the cyclonic area, and the greatest sustained wind velocities occur as a

FIGURE 1

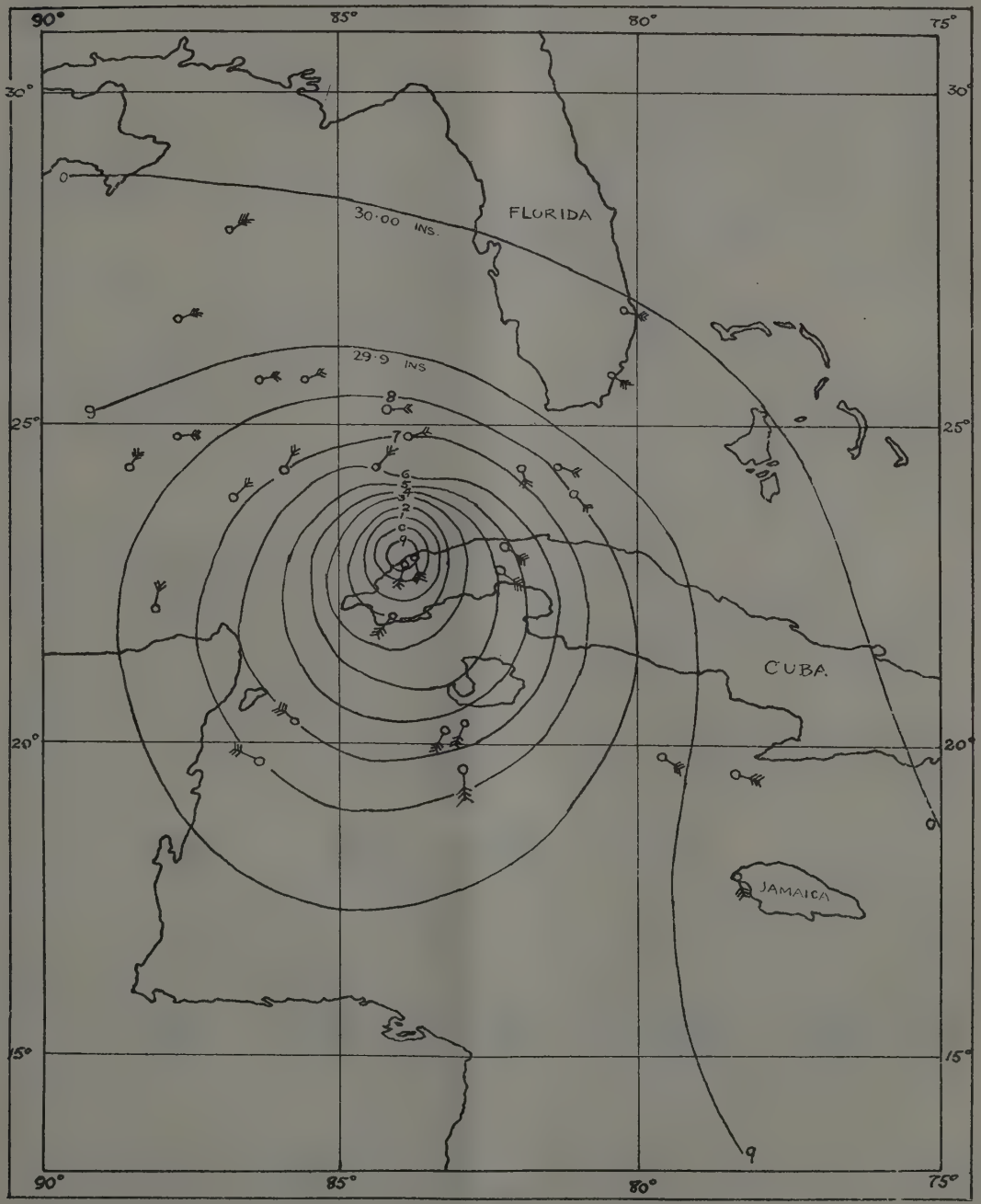
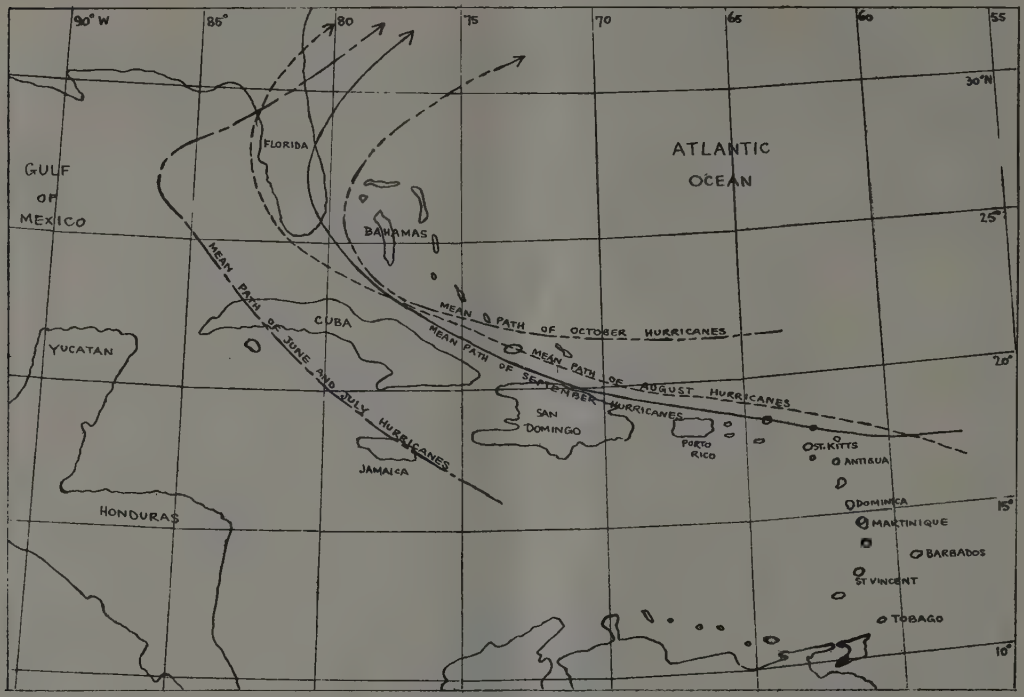

90°
85°
80°
75°
30°
25°
20°
15°
30.00 INS.
29.9 INS
FLORIDA
CUBA
JAMAICA
0
9
8
7
6
5
4
3
2
1
0
9

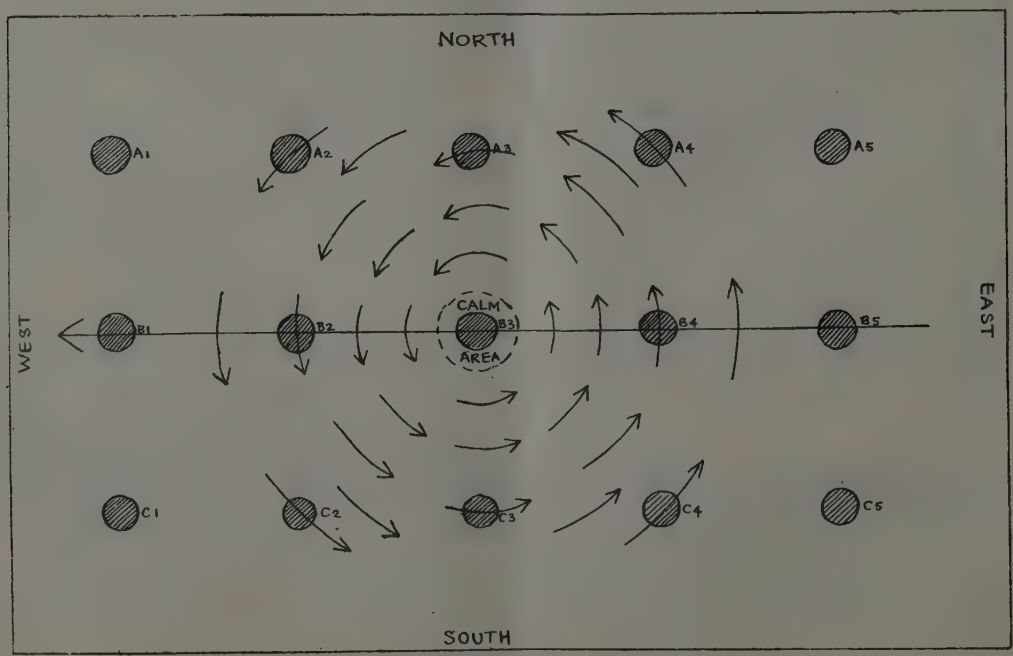
FIGURE 2.



MEAN PATHS OF WEST INDIAN HURRICANES FROM 1876 TO 1911

(Taken from O. L. Fassig – "Hurricanes of the West Indies".)

FIGURE 3.



rule in the right rear quadrant". These facts should be borne in mind by an observer when it has been determined whether the right or left section of an approaching hurricane will pass over the point of observation and when the relative positions of the latter in respect of the centre of the hurricane have been estimated. (*See* fig. 3.)

Excessive rainfall, another destructive characteristic, is experienced in certain parts of a hurricane. A rainfall of five to ten or fifteen inches is usually recorded during a hurricane. Cline (2) states that the rainfall in a cyclone is not equally distributed around the centre, but the greatest rainfall occurs in the front and a little to the right of the line along which the centre is advancing, and that relatively little rain falls in the rear half of the cyclone. From this statement it will be seen that sometimes an island or part of an island may be so placed relatively to the centre of a storm that it may escape from the destructive area but yet come within the area of and benefit from heavy rainfall, where the latter is of economic importance.

Section III.—Origin: Continuous Re-development: Death of a Hurricane.

The cause and dynamics of tropical cyclones are still imperfectly understood. In the preceding section it has been suggested that a hurricane is a system of revolving air carried along in the main air current of the region of its formation.

A discussion of the properties of revolving fluids is outside the scope of this article; it is sufficient to say that meteorologists have formed the opinion that the observed characters of tropical cyclones fit in well with the theory that hurricanes are examples of revolving fluid as stable dynamical systems carried along in the wider currents of the atmosphere.

Now the revolving motion of the system is associated with a suction of air towards the centre. If the surrounding air near the ground approached the centre without any outward displacement taking place above there would be an accumulation of air above the central area, resulting in an increase of atmospheric pressure in that area; but it is a well known fact that the pressure is lowest, not highest, in the central area. It is therefore essential that while the air at ground level is moving inwards the air at the centre must be moving upwards and outwards, (3) and the amount of air that moves upwards must be greater than that which is drawn inwards at the surface level in order that the pressure may continue lowest at the centre. The formation of a hurricane would therefore appear to depend upon conditions which cause air to rise and move outwards over a sufficiently wide area, and air to converge or move in from all sides to take its place in the attempt to re-establish pressure equilibrium.

Shaw (1) states: "Considering hurricanes to be dynamical systems of revolving air formed in a flowing current, it seems hardly possible to find any source except convection, reinforced by the latent heat of condensation, for the vast amount of energy which they develop." The chief alternative theory is the mechanical theory that tropical cyclones develop as circular whirls at the boundary between opposing currents of air. Such opposing currents of air are known to exist in all the regions where tropical cyclones are developed, and do not exist in the South Atlantic where these storms do not occur. It is possible (3) that the meeting of these conflicting winds leads to the formation of eddies and ascending currents, and that the latter form an important stimulus in deciding the locality of formation of cyclones according to the convectional theory.

It has been observed that tropical cyclones are formed in the regions of warmest sea water. This fact strongly suggests that convection from the surface is the cause of their formation. The atmosphere over the surface of warm sea water becomes moist and heated relatively to its surroundings and in consequence ascends. The removal of air by this process brings about a diminution of pressure and causes cooler air to move in from all sides towards the area of lower pressure.

Now it is an established fact that the rotation of the earth on its axis causes every body which moves freely over its surface with no force upon it but that of gravity to turn to the right in the Northern hemisphere and to the left in the Southern hemisphere. Within six or eight degrees of latitude on either side of the Equator, known as the doldrums, the tendency for deflection is inappreciable, but beyond this limit currents of air are deflected to the right in the Northern hemisphere and to the left in the Southern hemisphere.

Considering therefore the movement of air towards an area of diminished pressure, the natural deflection will result in a circular motion around a centre (*see* figs. 4 and 5) that is, external air converges towards an axis and the beginnings of a system of revolving air are set up by the dynamical consequences of the original thermal process. Shaw (1) states: "Continued further the same process will continue to remove the internal portion of the revolving column until the rotation has become sufficiently developed to resist further convergence towards the centre . . . The axis then becomes practically unapproachable because the air that aims towards it is always deviated from its course . . . So we get a dynamical system of great stability which admits air to the region of the axis only along the immediate surface, where the motion cannot reach the limit of protection, because it is retarded by friction."

FIGURE 4.

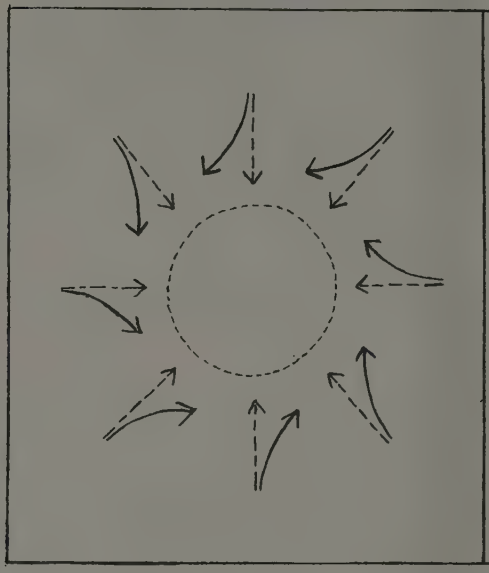


FIGURE 5.

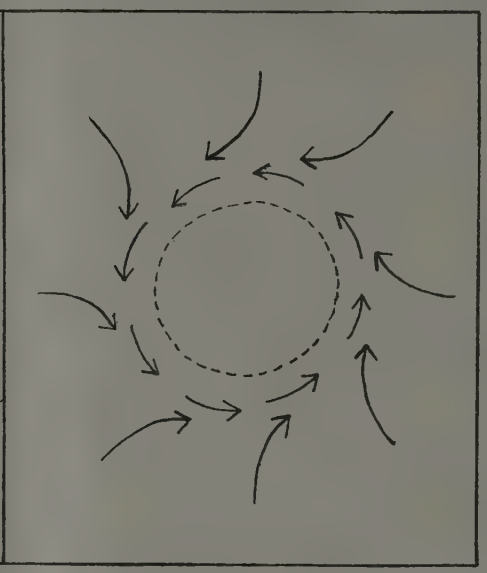


FIGURE 6.

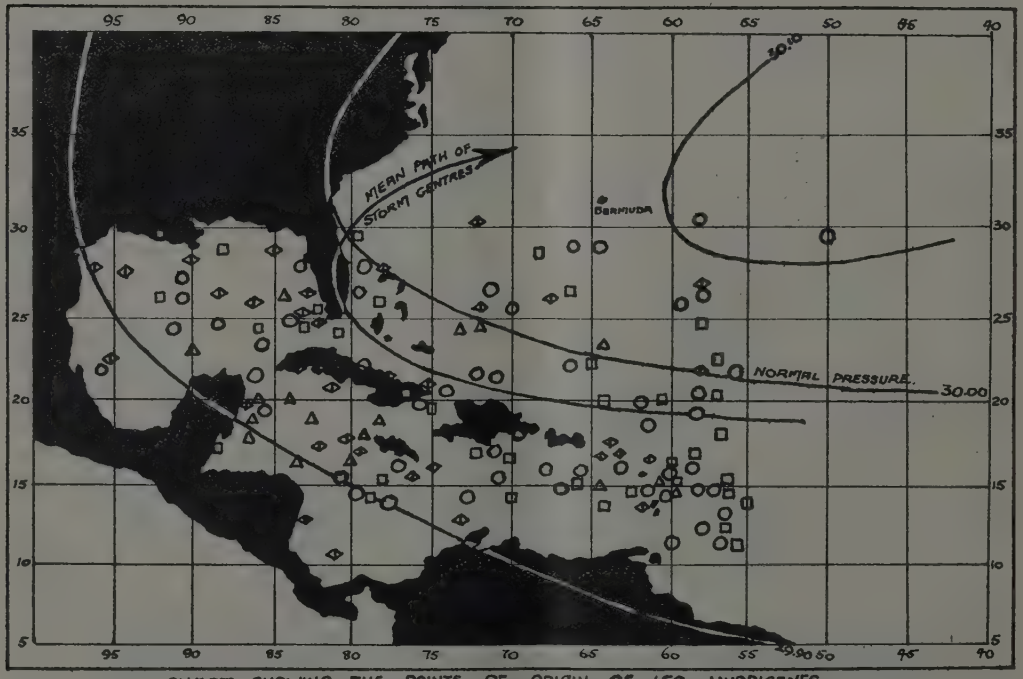


CHART SHOWING THE POINTS OF ORIGIN OF 150 HURRICANES.

△ SHOW ORIGIN OF JUNE AND JULY STORMS.
□ SHOW ORIGIN OF AUGUST STORMS.
○ SHOW ORIGIN OF SEPTEMBER STORMS.
◇ SHOW ORIGIN OF OCTOBER STORMS.

From Fassig's "Hurricanes of the West Indies" (with additions by Newnham.)

Maintenance, Continuous Re-development and Death.

In the preceding paragraphs of this section an indication has been given as to the cause and mode of formation of a tropical cyclone. Shaw(1) states: "When once the dynamical system is established it becomes a separate entity and is subject to the laws of gyrostatic phenomena." The cyclone having passed through the stages of formation is now a vast system of revolving air carried along in the Caribbean in the main air current flowing from East or Southeast to West or Northwest, and depending upon certain conditions for its existence. Energy is required to start the cyclone and energy is required to maintain it.

It has already been stated that tropical cyclones originate in the regions of warm moist atmosphere. When this warm air rises it is cooled and the moisture is condensed in the form of rain: in the process of condensation energy in the form of heat is given out: this continues and increases the convectional process and thus continues to rush more air into the system and maintain the furious whirl around the centre.

Cline (2) who has made careful studies of the behaviour of West Indian Hurricanes in the Gulf of Mexico and the Gulf States of America, states, "The convergence of the winds from the right rear quadrant with those of the right front quadrant causes air to ascend: the momentum carries the ascending air mass forward into the the front of the cyclonic area expanding and cooling as it reaches higher levels: the vapour of water in the nearly saturated air mass is rapidly condensed, giving excessive precipitation in the front and in the right front quadrant of the cyclonic area . . . The liberation of latent heat resulting from the condensation of moisture in the ascending air mass is greatest over the region of greatest precipitation intensity, consequently the air over the region of greatest precipitation intensity ascends much more rapidly than the air outside where the precipitation is less. The air moves in from various directions towards the depression caused by the ascending air, the deflective force of the earth's rotation comes into play, and the centre of the cyclonic action is continuously renewed with new systems of rotation forming over the area of greatest precipitation intensity . . . There is no question but that the centre of energy in the cyclone and the centre of the cyclonic action is continually renewed in the cloud strata over the region of greatest precipitation intensity." The most important factor in the maintenance and continuous re-development of a hurricane is a supply of warm moist air; in this respect Cline (2) states: "The energy of the cyclone is released and comes into action in the region of greatest condensation and precipitation intensity but the air stream in the right rear quadrant of the cyclonic area, which moves forward continuously in the line of advance of the cyclonic area, is the real source which supplies the material from which the energy is produced."

At the time of formation of a hurricane moisture-laden air rises: the moisture condenses and produces energy. After the hurricane has formed, the wind current in the right rear quadrant continues to draw moisture-laden air from the ocean hundreds of miles to the rear of the hurricane into the right front quadrant of the hurricane where the moisture is condensed and the centre of the cyclonic action continually renewed. This process continues until the hurricane either progresses so far inland as to lose its supply of moisture laden air, or passes out of the regions of warm moist air and draws upon cold drier air. The ultimate result of the operation of either of these conditions is the cessation of the supply of energy: there is no longer a renewal of the cyclonic centre, the pressure in the latter continually increases and the ring of maximum velocity is widened and depressed. In some cases the death of the cyclone may be a lingering one, but it must eventually die when the velocity of the vast whirl is sufficiently reduced and its area correspondingly extended. It is possible also for the death of a hurricane to result from the destruction of the dynamical system by the development of differences in velocity at different levels in the air in which it is being carried.

Section IV.—Hurricane Zone in the West Indian Area.

A record of the tracks of numerous hurricanes observed in the West Indian area over a long period of years has made possible the determination of an average hurricane zone or belt in some part of which the great majority of West Indian hurricanes originate and move. This average belt or area approximately extends from longitude 54°W to 90°W and from latitude 11°N to 28°N, or is roughly confined to the area embracing the Caribbean Sea, the Gulf of Mexico and the West Indian Islands (*see* Figs. 2 and 6). Hurricanes, however, do occasionally originate outside the Eastern limits of this zone and others proceed beyond the Western and Northern limits.

Originating therefore in the vicinity of the Eastern West Indies or to the East of the West Indian area, hurricanes normally progress on a West-northwesterly course or to the North of the Lesser Antilles, turning to a Northwesterly course in the Greater Antilles and entering or bordering on the mainland of the United States in the neighbourhood of Florida and the Gulf States, and then, if still maintained, recurving on to a Northeasterly course across the Atlantic Ocean. (*See* Fig. 2.) It usually happens that hurricanes diminish in intensity after entering the mainland of the United States; those that pass out on to the Atlantic Ocean again usually retain their identity for a time, but their intensity diminishes in higher latitudes, and they finally dissipate over the ocean or on or near to the Western coasts of Europe. It is not always, however, that hurricanes cover the complete track outlined above; some hurricanes originate

further West in the belt, some do not recurve at all but dissipate over the mainland of the Southern United States, others dissipate over the Atlantic and never reach Europe.

In the preceding paragraph the normal position of origin and progress of West Indian hurricanes has been briefly outlined. An indication of the reason for this definite area of formation and direction of movement is given in the following remarks.

Tropical cyclones occur in those parts of the tropics where the main wind currents have passed over a long stretch of equatorial or intertropical ocean. Now there persists a more or less permanent anti-cyclone, a region of high atmospheric pressure, extending from the vicinity of the Azores West-south-westward across the Atlantic over Bermuda to the Eastern coast of the United States. (*See* fig. 6.) The distribution of this pressure and its seasonal variation determine the direction of movement of various air currents. Thus the wind currents which reach the Eastern end of the West Indian area will have travelled over warm sea for about 30 degrees of longitude, and continue to pass over the warm sea of the Caribbean. This air current and consequently the Northern boundary of the hurricane zone is limited on the Northern side by the area of high pressure which extends Southward to latitude 25° or 30° N. The Southern boundary of the hurricane zone is determined by the weakening of the deflective force of the earth's rotation as the Equator is approached.

In the Caribbean area these warm moist air currents form trade winds of the hurricane season which blow in the Eastern Caribbean from the East and East-southeast and take the newly formed hurricanes along in a Westerly and West-northwesterly direction. In the Western Caribbean and Gulf States of America the winds forming the continuation of these trade winds blow from the Southeast and South, taking hurricanes in a Northwesterly or Northerly direction. Finally those hurricanes which pass out on to the ocean from the American mainland and those which recurve before reaching the mainland are carried along in a Northeasterly or Easterly direction by the Southwesterly and Westerly winds of the middle latitudes.

In Section III it has been stated that the energy of a hurricane is derived from the condensation of moisture: it therefore follows that the intensity of a hurricane is dependent upon the supply of a warm moist air stream. Conditions favouring the supply of such an air stream throughout the Caribbean are frequent during the hurricane season, consequently hurricanes entering the Eastern Caribbean are usually maintained with great intensity throughout their passage across the West Indian area. When, however, the hurricanes move inland over the American Continent they are no longer over the warm surface of the sea and can only be maintained so long as the wind current of the right rear quadrant continues to draw moisture-laden air from the neighbouring ocean. Some hurricanes, repelled by higher pressure over the continent, are driven across the Southeastern States of America and regain the ocean and their supply of moisture before the process of starvation has gone too far.

On passing into the middle latitudes the violent West Indian hurricane gradually loses its intensity and assumes the characteristics of the more moderate cyclone of temperate regions. This loss of intensity is partly the result of the diminishing supply of energy as colder air is encountered and partly the result of the effect of latitude.

Yearly Frequency and Monthly Distribution of Hurricanes in the West Indies.

The number of hurricanes occurring year by year in the West Indies is very variable. During the last half century tropical storms have been recorded each year, but the intensity of these storms has not always been sufficient to place them in the category of hurricanes. According to Newnham (4) as many as eleven hurricanes have been recorded in one year (1886 and 1887) in the West Indies. Within the last 20 years the greatest number has occurred in 1916, for which year eight hurricanes and several minor tropical storms are recorded.

Hurricanes rarely occur in the West Indian area at any time of the year other than during the months of June to November, and by far the greatest number occur during the months of August and September and the first half of October. The rare instances of the occurrence of hurricanes at times not within the period June to November are reported from the Western and Northwestern sections of the Caribbean area and are not known to have occurred in the Lesser Antilles.

The storms of June are mainly confined to the Western section of the Carribbean and seldom develop hurricane intensity, and the duration of their existence and consequently the length of their tracks is comparatively short.

The storms of July do not greatly differ in size and number from the storms of June, although as August conditions advance they occasionally originate in the Eastern Caribbean. As recently as 1926 a hurricane originated not far East of Barbados passing near to Barbados on the 22nd of July while still in its early stages as a storm of slight intensity, but developing during its progress through the West Indian area into a severe hurricane and causing extensive damage in the Bahamas and Florida.

In the months of August and September the number and intensity of hurricanes greatly increase. The position of their origin moves Eastward to the Eastern Caribbean or further East in the Atlantic Ocean, and not infrequently even so far East as the vicinity of the Cape de Verde Islands. It is therefore during these months in particular that the Eastern section of the West Indian area

is subject to the visitation of hurricanes. The further East the hurricane originates the more likely is its intensity to be greater on reaching the West Indian Islands.

Following upon diminution in the frequency of occurrence of hurricanes in the West Indian area in the latter half of September, records show that there is an increase in the frequency of occurrence in the first half of October, but the normal position of origin now moves back Westward. October hurricanes are more frequently formed in the Western Caribbean, but occasionally like many August and September hurricanes, they originate far to the East of the West Indies and develop great intensity before reaching the West Indian Islands. It is noteworthy that one of the severest hurricanes in the history of Barbados, the Eastern-most islands was that of the 10th of October, 1780.

After the middle of October there is a rapid decline in the frequency of occurrence of West Indian hurricanes. Those that do occur are mainly confined to the Western Caribbean area, and are rarely experienced in the Eastern Caribbean. A considerable number of the storms of late October do not develop hurricane intensity.

Storms of hurricane intensity in November are very rare and no such storm has been known to occur in the Eastern Caribbean. November hurricanes have, however, occurred in the Western Caribbean and of special interest is the severe hurricane of the Western end of Jamaica in November, 1912.

(*To be continued.*)

RUSSIAN COTTON.

THE larger imports of Russian cotton to the United Kingdom are causing considerable interest in Lancashire. It is reported that since August 1st., 1930, about 120,000 bales have been received in England and the value is estimated at over one million pounds sterling. This Russian cotton is of good grade and staple, and compares favourably with the best types of Texas varieties, but users state that the price is fully ¼d. per lb. cheaper than similar American styles. A feature of the Russian staple is its strength. Substantial quantities have been used during the last few months by the Lancashire Cotton Corporation Ltd., and it is understood that about fifty firms in Lancashire have experimented in spinning it, the reports being generally satisfactory. This development in the raw cotton trade has caused much comment in certain quarters, and reports are being circulated that Russia is growing this cotton under slavery conditions, but there is no proof for such statements. On behalf of Lancashire spinners it is held that, owing to the severe world competition which now exists, users cannot afford to ignore the opportunity of buying Russian cotton when it is so attractive and more economical than other varieties.—(*The Economist*, Vol. CXII, No. 4,568.)

SWEET POTATO STORAGE TRIALS.

By J. G. BRASH.

[*The following article describes preliminary experiments carried out at the Imperial College of Tropical Agriculture on the Storage of Sweet Potatoes.*]

Introductory.

SWEET potatoes are generally considered not to store well in Trinidad, and the peasant as a rule markets his tubers as soon as they are harvested. Tubers may, of course, be left in the ground after maturity. This practice, however, is undesirable as decay and sprouting eventually take place. As it might be financially advantageous to store sweet potatoes at certain seasons of the year, a number of storage trials were made at the Imperial College of Tropical Agriculture. The main object of these trials was to discover a method of storage which would insure least loss through decay and through shrinkage resulting from evaporation of moisture and the effect of chemical change.

Description of the Storage Trials.

The trials were conducted over the period 5th December to 30th January, 1931. Sweet potatoes of the Jackson variety were used. In each case, the quantity of material employed was 160 pounds weight. At the beginning of the trials, the tubers were in fair condition and free from decay. The following six methods of storage were tested.

1. Tubers stored in a round conical outdoor "pit," or clamp. The base of the "pit" (three feet in diameter) was prepared by digging out three or four inches of soil, levelling, and lining with a layer of rice straw. The tubers were stacked in a conical heap, well covered with straw, and a covering of three inches of soil added on top.

2. Tubers stored in a similar pit but provided with ventilation by means of two trenches (four inches deep and four inches wide) dug at right angles across the floor of the pit so that their ends extended outside the pit area. At the point of intersection, a pipe was placed obliquely, thus supplying a current of air which entered at the ends of the trenches, passed underneath the tubers, and escaped up the pipe. The pipe was laid obliquely to prevent the entry of rain. The trenches were covered with board.

3. Tubers stored in layers alternating with layers of sand in a square pit dug in the floor of a grass hut. (Barbados method.)

4. Tubers stored in bags, in a dry, concrete-floored, well-lighted and ventilated building, the bags resting on boards.

5. Tubers stored in a heap piled on sacking in the same building.

6. Tubers stored in a layer three to four inches deep on the shelf of a wire-net corn crib, sacks being laid underneath the tubers to prevent injury. The shelf was about ten feet above ground, thus affording complete ventilation.

The tubers in each case were examined periodically, and all those showing signs of decay were removed and weighed. The results are summarised in the following tables :—

Table I.

Treatment.	Original weight.	Final weight of sound tubers.	Loss due to Decay.		Loss due to Shrinkage.		Gross Loss.	
			Total weight.	Per cent. of original weight.	Total weight.	Per cent. of original weight.	Total weight.	Per cent. of original weight.
	lb.	lb.	lb. oz.	Per cent.	lb. oz.	Per cent.	lb. oz.	Per cent.
Pit	160	135½	7 2	4.5	17 6	10.8	24 8	15.3
Ventilated Pit..	160	131½	10 1	6.3	18 7	11.5	28 8	17.8
Sand Pit ..	160	120½	36 13	22.5	2 11	1.7	39 8	24.7
Bag	80	59½	5 13	3.6	14 11	18.4	20 8	25.6
Heap ..	160	115½	12 13	8.0	31 11	19.8	44 8	27.8
Corn Crib ..	160	74	32 0	20.0	54 0	33.8	86 0	53.8

Table II.

Rate of Decay.—Extent of decay as ascertained by fortnightly inspections expressed as per cent. of original weight of Tubers.

Treatment.	19th December.	2nd January.	16th January.	30th January.
	Per cent.	Per cent.	Per cent.	Per cent.
Pit	0.6	2.7	3.2	4.5
Ventilated Pit	1.4	2.1	3.5	6.3
Sand Pit	0.3	1.9	7.5	22.5
Bag	—	1.9	4.8	3.6
Heap	0.3	1.8	4.3	8.0
Corn Crib	2.2	13.1	15.0	20.0

Discussion of Results.

The data contained in Tables I and II indicate the following features in respect to suitability or otherwise of the various methods of storage.

1. *Pit Method.*

Decay was almost negligible, and loss due to shrinkage was low. The tubers suffered very little from insect attack, and sprouting was inconspicuous. The appearance of the tubers at the end of the test was very good.

2. *Ventilated Pit Method.*

The results obtained in this test were very similar to those obtained in unventilated pit method. Ventilation, therefore, appears not to offer any advantages.

3. *Sand Pit Method.*

Least shrinkage occurred here; the tubers retained their fresh appearance, and showed no signs of decay until the end of the first month. Subsequently, however, decay developed rapidly. Insect damage was considerable (nine per cent.). The tubers sprouted, but the shoots died after four weeks.

4. *Bag Method.*

Decay was here least of all, but shrinkage was considerable. Insect damage was small, and the final appearance of the tubers was satisfactory.

5. *Heap Method.*

Decay was not very marked, but loss through shrinkage was high. Insect damage was small; little sprouting occurred, and the general appearance of the tubers was good.

6. *Corn-Crib Method.*

Very high loss occurred both from shrinkage and from decay, including damage by weevils and other pests, as well as rot due to fungi (15 per cent.). The final appearance of the tubers was very unattractive.

The stored tubers at the end of the tests were inspected by the overseer, who has had considerable experience of sweet potatoes. They were all judged to be saleable, with the exception of those stored in the corn-crib (No. 6) and in the sand pit (No. 3). Their market value was assessed at about 2 cents per pound, freshly dug sweet potatoes being worth 2½ cents per pound at the time.

Financial Significance of Tests.

The highest prices for sweet potatoes apparently prevail in June, July and August. The tests indicate (*a*) that storage for at least two months is possible (*b*) that the best method is the pit method (*c*) that a total loss in weight (during two months) of about 15 per cent. (or three cwts. per ton) may be expected; and (*d*) that the stored tubers would fetch rather a lower price, say ½ cent per pound as compared with that ruling for freshly-dug potatoes.

The Government Ground Provision Depôt price for sweet potatoes at the end of April, 1930 was 1½ cents per pound but the July price was 3 cents per pound. One ton of potatoes marketed at the end of April would therefore have brought a return of $33.60 (at 1½ cents). If the ton of tubers had been stored for two months, the weight would have been reduced to 17 cwt., but the tubers would have sold for 2½ cents per pound (allowing ½ cent per pound market preference for fresh tubers). The return would then have been $47.60. It would thus appear that the selection of a proper method of storage of sweet potatoes is a matter deserving consideration.

APPENDIX.

Shrinkage of Sweet Potatoes.

The storage trials described above furnish an approximate estimate of the extent to which sweet potatoes suffer shrinkage on storing (as distinct from decay). In order to gain a more accurate figure for shrinkage, a separate small-scale experiment was conducted. Twelve good-sized tubers were selected and carefully stored on a shelf in the Farm Office. The tubers were obtained locally, and had been harvested on the day of the first weighing. The tubers were weighed on harvesting, again four days later, and every sixth day thereafter. Results obtained up to the end of January are recorded in Table III.

Table III.

Date.	*Average weight.*	*Loss in weight to date.*	*Loss in weight to date as percentage of original weight.*
	oz.	oz.	Per cent.
19th Dec. ...	11.05	—	—
23rd Dec. ...	10.5	0.55	5.0
29th Dec. ...	10.2	0.85	7.7
4th Jan. ...	9.7	1.35	12.2
10th Jan. ...	9.7	1.35	12.2
16th Jan. ...	9.8	1.45	13.1
22nd Jan. ...	9.55	1.5	13.6
28th Jan. ...	9.45	1.6	14.5

(On 16th January two tubers were removed as they showed signs of decay: the weights recorded thereafter are averages for the remaining ten tubers.)

The tubers commenced to lose weight rapidly after being harvested. A loss of five per cent. was sustained during the first four days. The loss increased quickly for about a fortnight, reaching 12 per cent. but further loss was very slight.

TOMASPIS OR MONECPHORA.

In the literature dealing with the Sugar-cane Froghopper of Trinidad, it is seen that the froghopper is referred to by some authors as *Tomaspis saccharina* Dist., by others as *Monecphora saccharina* Dist., and occasionally the form *Monecphora* (*Tomaspis*) *saccharina* Dist. appears.

This apparent confusion is the result of variations of opinion as to the subdivision of the Fabrician genus *Cercopis*, and a discussion of the question appears in a recent paper by Miss Kathleen C. Doering (Synopsis of the Family *Cercopidae* (Homoptera) in North America. J. Kansas Ent. Soc., Vol. III, Nos. 3 and 4, 1930, pp. 54-55).

The original genus *Cercopis* Fabr. was divided into six genera, *Cercopis, Rhinaulax, Tomaspis, Triecphora, Monecphora* and *Sphenorhina* by Amyot and Serville (1843). As the distinction between the genera, viz. the relative prominence of the carina on the post-clypeus is not distinct or constant, Stăl united the genera *Tomaspis, Triecphora, Monecphora* and *Sphenorhina* in one genus, *Tomaspis*. This view also is taken by Fowler and by Miss Doering, while Oshanin retains the genus *Triecphora* and Van Duzee (1919) retains all six genera as erected by Amyot and Serville.

Until a study is made of the whole group, therefore, the matter may be taken as simply a question of opinion. It must be added, however, that in the sugar-cane froghopper, the carina is quite prominent, which does not agree with Amyot and Serville's description of *Monecphora* and it is, therefore, probably more convenient to retain the generic name *Tomaspis* for the present.

A.P.

WEST INDIAN NOTES.

(Compiled by the Advisory Department of the Imperial College of Tropical Agriculture.)

St. Kitts.

Drought conditions continued in St. Kitts up to the middle of April, the rainfall for the year amounting to only two inches. Towards the latter half of April and throughout May good rains were experienced and the agricultural outlook improved. The sugar crop which averages about 16,000 tons will probably not exceed 12,000. The sucrose content of the canes is high and the factory recovery is excellent, but the field returns in certain districts are extremely low. The newly planted cotton crop is growing satisfactorily. Much of last year's crop remains unsold, and planting has been restricted this year. In spite of unsatisfactory weather conditions 27 planters undertook the production of fruit and vegetables for the Canadian market. Some 90,000 lb. of tomatoes were exported, equal to 4,600 crates. The results were promising. The produce was received at the newly opened Government Fruit and Vegetable Bureau where it was graded, packed and shipped under the supervision of the Agricultural Department. The need for cold storage facilities for storing fruit between the arrival of steamers was very evident, there being much wastage. A cold storage and ice making plant is being erected, however, with the help of funds generously provided by the Imperial Government, and this will be ready in time for the 1932 crop.

An important sugar-cane manurial experiment run in co-operation with one of the estates, has recently been completed by the Agricultural Department. Probably, owing to the unusual weather conditions, the results from this carefully planned and closely supervised experiment were entirely negative, the control plots not being significantly inferior to those receiving heavy and moderate applications of chemical fertilisers. The trials, however, will be repeated over a number of years. A very interesting experiment is also being undertaken on two estates in St. Kitts to determine the effect, on the yield of cane, of very heavy applications of artificial manures to plant canes. These plots were recently examined and a very even stand of cane has been secured but the manures have not yet exerted any influence on growth.

Nevis.

The island of Nevis has experienced one of the most severe droughts in its history. For nine consecutive months in 1930 only a little over 16 inches of rain fell, and for the first three and a half months of 1931 the rainfall was under three inches. There was a welcome change in April. The position was so acute that it was impossible to keep the island stock alive, the supply of fodder, including on some estates, coconut leaves and mango bush having failed completely. The people were maintained by relief work provided by the Government, and ground provisions had to be imported from St. Kitts. The cotton crop which was sown after the rains of November, 1930, has been bought by the Government, and will be shipped on behalf of the peasants. Close on 100,000 lb. of seed cotton was received at the Government warehouse. The Government's action in coming to the assistance of the small-growers is much appreciated. With the advent of rain there was a keen desire to plant provision crops but planting material was very scarce. Nevis, in spite of almost impossible climatic conditions, produced 1,300 boxes of vegetables for export to Canada. These have been very favourably reported on both as regards quality of produce and excellence of pack. Thanks to the assistance rendered by the Colonial Development Fund Committee, a cold storage plant has been erected and a successful trial run made. The system of land tenure in vogue in Nevis has for a considerable time been severely criticised by agricultural authorities. Information has recently come forward, however, that funds have been made available to enable the local Government to purchase three or four estates and to lay them out as land settlement schemes. Much benefit is expected to accrue from this.

Anguilla.

The agricultural instructor reports that a small area of land has been enclosed as a demonstration and nursery plot and planted with a number of the better varieties of the various ground provision and vegetable crops usually grown on the island. The most promising of the new varieties will eventually be passed on to the growers. The cotton crop is fair but late. A close season has to be rigidly enforced even if the second cotton crop has to be largely sacrificed. By this means alone can the various insect pests be kept under control.

Antigua.

The year 1930 was probably one of the driest on record, the rainfall registered being just 30 inches. The first three months of 1931 passed with only three inches of rain falling. Latterly there has been some improvement, but the need for " pond " rains was very great. Under the circumstances it is not surprising that the sugar crop is short, but the seriousness of the position can best be realised by comparisons of crop returns. Antigua in 1928 made a sugar crop of 18,900 tons; in 1929 of 9,700 tons and in 1930 of 16,700 tons. The estimated crop for 1931 was 5,500 to 6,000 tons. Great difficulty has been experienced in establishing the young crop for 1932, and in many instances it has been necessary to replant twice or even three times. The cotton crop was practically over in April and a close season extending from 15th June to 31st July is to be enforced. The Antigua Cotton Growers' Association continues to function with great benefit to the industry but its resources are being severely strained in the present crisis and the need for a quicker turn over of stocks is badly felt. The vegetable industry which the Government is fostering in every possible way suffered the same

fate as other crops, and it was only found possible to export some 400 boxes. In addition there was a brisk local demand. The Agricultural Department which has recently been re-organised has almost completed the removal of the Experiment Station from Skerretts to Greencastle. A portion of the latter estate, recently purchased by the Government for land settlement purposes, has been fenced in and will be used for experimental purposes. There is also enclosed within this area a demonstration small holding. The prolonged drought has been partly responsible for the reduction in the number of peasants taking up lands on the new settlement.

Through the generosity of one of the planters who supplied the manure and the labour, two carefully planned manurial experiments have been laid down recently in co-operation with the Agricultural Department. Unfortunately the germination of the plants on these plots has been unsatisfactory and a count has been made of the variation of the plots in this respect. A very interesting series of experiments to determine the effect of heavy applications of commercial fertilisers, laid down by another group of estates, has also suffered seriously from the same cause. The Department's demonstration plots in the growing of vegetables for the Canadian market proved interesting and instructive. They were not a commercial success owing to abnormal weather conditions but they afforded valuable experience in the growing of such crops as tomatoes, cucumbers, melons, eggplants, &c. The Government, through the Agricultural Department set up a Central Packing Station for the receiving, grading, packing and shipping of fruit and vegetables. This functioned for the first time during 1931. The Department has lost the services of Mr. Gallwey, the Agricultural Officer, who was compelled to retire on account of ill health.

Montserrat.

The drought conditions recorded for the more Northern Islands have this year persisted further south, and even Montserrat, Dominica, St. Lucia and Grenada, have experienced unusually long and severe dry periods. Agricultural activities in Montserrat have thus been materially retarded. The volume of the vegetable crop was seriously reduced and the sowing of the cotton crop delayed. By the end of April useful rains had fallen and the cotton crop had been put in. The planters loyally co-operated with the Agricultural Department in an attempt to improve still further the quality of Montserrat cotton. Following on the advice of Dr. Harland, the Government at the request of the cotton growers recently introduced an ordinance to control the quality of the seed supply of the Island. It is now illegal to sow cotton seed unless such seed has been previously certified by the Agricultural Department as coming up to a certain specified standard. It is also illegal for any person to have in his possession any cotton seed not so certified after 15th January in each year, this date being a few weeks prior to the opening of the new planting season. The vegetable trade with Canada made further progress during the 1931 season and in all close on 18,000 crates were shipped. This fell far short of the anticipated crop but showed an increase of 13,000 crates over last year. This increased volume was handled in Canada by the Canada-West Indies Fruit Co., Ltd. of Montreal whose representatives have visited the West Indies on several occasions. They arranged to handle the crop on a co-operative basis, a certain payment for the produce f.o.b. steamer being guaranteed by them to be followed by a distribution of profits after certain charges had been deducted. This Company handled the business to the satisfaction of the growers and it is hoped that a similar arrangement will be made for future crops. The Company insists that the fruit should be received, packed and graded at the Government Central Packing Depot, which is in charge of the Agricultural Department. A cold storage and ice making plant has been erected near the landing stage. During April information came forward that the application for a loan to purchase the Experiment Station which is located on private property had been approved. This will place at the disposal of the Department additional land for experiment and demonstration purposes and enable the Government to undertake permanent improvements from time to time. At a recent meeting of the Agricultural Society the question of the name of the cotton grown in the Island was discussed and it was finally decided in future to refer to the cotton as ' Montserrat ' cotton.

Dominica.

The serious economic position of the Island which is due to losses caused through hurricane and disease of its major industry, limes, is being severely felt. It is now passing through the phase when the young trees are yielding no crops and planters have to find money to maintain them. In addition to this, owing to an unusual spell of dry weather, it is with the greatest difficulty that one and two year old trees are kept alive in the field and in some cases a number of trees are dying. It will be several years before the economic position of the Island will be satisfactory and much hard work remains in front of all concerned. The few planters having bearing lime trees are realising satisfactory prices for green limes and lime oils. The lime as a source of citric acid has lost its place, concentrated lime juice being almost unsaleable at such a low figure as £8 per pipe. Several years ago a number of planters and peasants on the Windward Coast towards the north end of the Island, undertook the planting of coconuts on a considerable scale. Many of these trees will, within a year or two, be reaching the bearing stage. The question of the most economical way of handling this crop will require consideration and it is anticipated that a co-operative copra or oil extracting plant will have to be erected. The Agricultural Officer in this area is about to engage on a survey of the coconut cultivations with a view to making definite recommendations. The fruit industry in

Dominica is making slow progress. This is probably due to the absence of good planting material on a reasonably large scale. The Agricultural Department is the only supplier of these plants and up to the present its energies have been taken up with supplying the more urgent demand for budded lime plants. Now that so many of the estates are producing their own budded limes the Department is in a position to concentrate more on the production of larger quantities of other budded citrus. This is especially so as the Imperial Government has placed at the disposal of the local Government ample funds for this service. Branch nurseries have now been started at The Cabrits, Hampstead, Marigot, and Grand Bay. During the last few months, small quantities of good quality oranges were received at the Government Fruit Packing Depôt for grading, packing and shipping to Bermuda. This fruit left the Island in excellent condition. The packing house is soon to be equipped with modern machinery for washing, grading and sizing, and under the same roof will be housed the Government cold storage and ice making plant.

St. Lucia.

The climatic conditions have been more normal in St. Lucia than in most of the Islands, though the rainfall has been low in Castries and in the south of the Island. The 1931 sugar crop has been variable. In the south it was extremely short owing to the dry weather, but at Roseau and Cul de Sac the cane returns were good, especially at Roseau where the field work of late years has shown marked improvement. On the other hand, the sucrose content of the cane was unusually low. The cocoa crop has been fair but root disease is taking a severe toll of the trees. At present prices the system of control suggested—isolation trenches and liming—is beyond the financial resources of the peasants and of many of the planters. The lime estates in the drier areas are promising and heavy shipments of green limes have recently been made to New York at remunerative prices. Several hundred boxes of mangoes of the common varieties are being shipped to Bermuda. These are now subject to Government inspection and much improvement is to be observed in the quality of the fruit and especially in the appearance of the packages since the provisions of the fruit ordinance have been enforced. Most of the packages have been manufactured locally by an enterprising planter who has erected a saw mill and planing machine for this purpose. The coconut plantations throughout the Island are in a healthy condition and there is a marked tendency to extend this cultivation in spite of the low prices now prevailing. Much of the land now being used for coconuts could be more profitably planted in other crops such as citrus and coffee, but planting material of the former is lacking. The plant distribution from Government nurseries should be greatly increased and this is now receiving the close attention of the administrative and agricultural authorities. The demonstration fruit farm at Union is making progress and the experiments with inter-cropping are interesting. Much could be done in St. Lucia with vegetable production for the Canadian market and with the establishment of a Government Central Packing Depôt and cold storage plant in the near future. A determined effort should be made to develop this trade.

St. Vincent.

When compared with the other Islands the climatic conditions in St. Vincent have been most favourable, over 14 inches of rain having fallen at the Botanic Gardens up to the end of April. The cotton crop planted in the autumn of 1930 has been successfully reaped and the large area of 4,000 acres has yielded a satisfactory crop. The cotton is purchased by the Government at the Ginnery and is shipped on behalf of the peasants. The initial payment this year was 2½*d.* per lb. of seed cotton. The close season has been fixed from 15th May to 31st August, and the peasants, of which there are over 1,500 growing cotton, cultivate between them 1,700 acres, are busily engaged in destroying the old stems, &c. The arrowroot crop is a normal one and the arrowroot pool which was started a few months ago is now functioning satisfactorily. The Fruit and Vegetable Depôt continues to afford peasants and others an outlet for their produce. The question of further Land Settlement Schemes is being enquired into by a Committee. There are certain districts in the Island where development on these lines is very desirable. The last estate was purchased by Government for this purpose in 1914, but there have been several privately owned properties which have been divided into small holdings since that date. The work at the Cotton Station continues and the arrangements for a satisfactory seed supply in the absence of a seed farm is receiving careful consideration. Dr. Harland paid a brief visit of inspection to the Cot on Station during the month of March.

Jamaica.

In connexion with the decision by the Legislative Council of Jamaica that this year's contribution by the Colony to the Imperial War Debt should be used for the assistance of the sugar industry, the Governor has stipulated that estate owners who share in the subsidy must give a guarantee that they will continue their operations in cane planting and sugar production during 1932.

This condition has been imposed in view of statements that were made in the Legislative Council that three sugar factories and an equal number of cane farms would cease to operate during this year. The Government has taken up the stand that a subsidy of close upon £2 a ton to sugar exported must also be considered from the angle of the welfare of workers on estates. The Governor and his advisers are anxious that large bodies of labourers should not be thrown out of work, to swell the ranks of the Colony's unemployed. The undertaking has been given by owners of sugar factories that they will cary on with the £60,000 assistance the industry will received from the State this year.—(*The Times.*)

MISCELLANEOUS INFORMATION.

Mr. C. A. Gomez, Curator of Montserrat, proceeded on six months leave on 9th May, 1931. During his absence Mr. E. S. A. Chin will act for him.

* * *

Professor C. Y. Shephard, Professor F. Hardy, and Mr. J. A. McDonald, have all paid visits recently to Grenada, details of which appear in the *College News Bulletin*.

* * *

Mr. F. G. Harcourt, Agricultural Superintendent, Dominica, proceeded on six months leave of absence on 28th March, 1931. Mr. F. L. Squibbs will act for him during his absence.

* * *

The appointment for three years of a marketing officer, to be attached to the College for duty in the Windward and Leeward Islands has recently been sanctioned by the Secretary of State for the Colonies.

* * *

At the request of their Government, Mr. G. A. Jones represented the Leeward Islands at a preliminary Conference convened on 15th June in Trinidad to discuss the question of closer trade relations with Canada.

* * *

Mr. R. E. Montgomery, M.R.C.V.S., Adviser on Animal Health to the Secretary of State for the Colonies, during his recent official visit to the West Indies, called at each of the Islands to discuss livestock conditions with Administrative and Agricultural Officers, and with many planters.

* * *

Mr. S. H. Evelyn, Cotton Research Officer, stationed in St. Vincent, at the request of the Commissioner of Agriculture, and with the concurrence of the British Cotton Growing, Corporation, proceeded on 2nd June to St. Kitts and Montserrat, where he will discuss cotton problems with the Agricultural Officers concerned.

* * *

The annual stock sale of the Trinidad Government Farm recently took place. Several parties requested the Advisory Department to bid for some of the stock and a few animals were secured for the Islands. In the majority of cases the reserve price fixed by the prospective purchasers was too low, and the animals were not secured. A list of the realised prices has been furnished to Agricultural Officers in each Island for future reference.

* * *

Mr. H. F. Nichols, a Student of the Imperial College of Tropical Agriculture, who has recently completed the Sugar course at the College, has been appointed Assistant Agricultural Superintendent in St. Lucia. Mr. G. B. Gregory, a third-year Diploma Student at the College, has been appointed to a similar post in St. Kitts. Before proceeding to St. Kitts, Mr. Gregory is to spend two weeks in St. Lucia taking a practical course in plant propagation.

* * *

Mr. E. Taylor and Mr. J. L. Johnson have been appointed Officers-in-Charge of the Government Fruit Depôts and Fruit Inspectors in Dominica and St. Lucia respectively. At the request of the Governments concerned, arrangements were made for these Officers to visit a number of citrus estates in Trinidad, to spend a few days in the Government nurseries, to inspect the cold storage plants at the College and in Port-of-Spain, and to spend a few days in the various packing houses in Trinidad.

* * *

Professor H. A. Ballou, Commissioner of Agriculture, will represent the Windward and Leeward Islands at the Sugar Conference to be held in London in July. He will also attend the Conference of Directors of Agriculture, which will be held at about the same time. Mr. G. A. Jones, Assistant Commissioner of Agriculture, who has just returned to Trinidad after paying an official visit lasting seven weeks to the Leeward Islands and St. Lucia, will act as Commissioner during Professor Ballou's absence.

A SOLID-FLESHED TOMATO.

THIS new variety of tomato (second year of its existence in England) was introduced into Queensland in August last. The seeds were sown in an old flower bed on 21st September without previously manuring the ground. In approximately three weeks the young plants were ready for transplanting. Germination of seeds was 100 per cent. The young plants grew at a wonderful rate, and developed in a remarkably short time, and would have reached a height of seven feet had they been allowed to grow unchecked. The fruit developed at an equal rate with the plants, forming clusters of from five to nine fruits on each cluster. The foliage is large and plentiful, and protects the growing fruit well. The fruit itself is excellent. It is round, well shaped, smoothed-skinned (no corrugation whatever), and gives an average of three to four to the pound. The skin is fine textured and may be peeled like that of boiled potato. The core is very short. The flesh is solid right through, so, that the tomato may be eaten like an apple. The seeds are few in comparison to other varieties. Its travelling qualities also appear to be of an excellent character as, several fruits picking when just showing a reddish hue ten days before a local horticultural show, were, at the date of the exhibition, just ripe for consumption. A crop of approximately 200 plants grown on very poor and shaley soil, yielded on an average eight pounds to the plant; but, of course, better results can be expected when cultivated under more favourable conditions.—(*Queensland Agricultural Journal*, Vol. XXXV, Part 4.)

TROPICAL WORLD NOTES.

Northern Rhodesia.

According to Colonial Report No. 1516, the acreages for the season 1928-29 under the staple crops of this territory were as follows :—

Maize ..	39,215	Wheat	2,698
Tobacco	3,232	Cotton	234

Although the acreage under maize was lower than during the previous season the average yield per acre increased by .60 bags per acre to 5.5 bags, a yield only once equalled before. This increase was a welcome indication to better husbandry specially as it occurred during a season which was not an ideal one. Considerable quantities of farm grown maize are handled by a Co-operative Society which has secured large contracts for the mines of the Belgian Congo where much of the crop is exported. Conditions in the tobacco market, owing to overproduction, remained difficult. Much attention, however, was paid to maintaining the quality of the Northern Rhodesia leaf, the grading and classification being supervised by a Tobacco Adviser who was authorised to refuse any leaf which was unlikely to find a satisfactory market. It is now quite proved that, in spite of the advantage of the preference on Empire leaf, the increased consumption is to be slow. The bright leaf, of which a considerable amount is produced, is used in the manufacture of cigarettes and the tobacco in those lines which have the largest sale has been blended for many years so as to obtain a distinct flavour. The leaf produced in Northern Rhodesia, although from Virginia seed, undoubtedly possesses a distinct flavour which would be imparted to the cigarette if large quantities were used in the mixture and the majority of the cigarette smokers of the United Kingdom have not yet acquired the taste for Rhodesian tobacco. The immediate outlook is much more hopeful as regards leaf for pipe mixtures. Many of these mixtures now contain a large proportion of Rhodesian leaf and there is no indication that the proportion will not still further increase. Both the acreage and average yield per acre of wheat showed increases over the previous year. Satisfactory progress is also being made, with the help of an Officer appointed by the Empire Cotton Growing Corporation, to discover a suitable variety of cotton seed.

The migration of labour to the mining areas is having a serious effect upon native agriculture as although the major portion of the cultivation of crops has always fallen upon the women, the men have been responsible for the work in connection with opening up new lands for gardens. Recently, however, the women have been compelled to cultivate old gardens where the soil has become impoverished with the result that the crops reaped have naturally been poor.

Owing to extremely good prices the cattle industry flourished during the year under review. It has been recognised for some time, however, that improvements are necessary in the cattle industry in the territory, and of the £160,000 set aside by the Government to assist the agricultural industry, a small amount will be utilized for the study of genetic and nutritional problems and the remainder in the form of loans, repayable over long periods and at a low rate of interest, for the erection of dipping tanks and fencing, and the importation of breeding stock. Money has also been reserved for the improvement of the native cattle industry and £4,000 for equipping a creamery. With the assistance now available it is felt that considerable advance will be made in the cattle industry of the territory.

* * *

Federated Malay States.

According to Colonial Report No. 1498 for 1929 much attention was devoted to the organisation of the Department of Agriculture by surveying the various lines of its activities, putting forward proposals for co-ordinating the work of the different divisions and laying down a definite line of policy for the future.

The aggregate value of trade showed an increase of 17.11 per cent. as compared with the previous year, chiefly owing to the large increase in the quantity of rubber exported, the area under this crop being 1,461,300 acres, and exports, 261,353 tons. The chief feature is the continued interest taken in budding. There has been a large increase in the importation of budwood of high yielding clones from the Dutch East Indies and considerable quantities of budwood are also being raised in this country. Manuring problems are also attracting increased attention; investigations indicate that on certain types of soil, potash is deficient and it is anticipated that the application of potash fertilisers will produce results of economic value. Much interest is also being taken in the question of soil conservation on a number of estates and in replanting problems on estates on which the tapping systems, loss of soil and root diseases are responsible for decreasing yields of latex. The most difficult problem is that of the reconditioning of soils for replanting. Experimental work on the question of substituting air dried sheet for smoked sheet is being carried out. The export of concentrated latex (revertex) is increasing.

The rice crop as a whole was a poor one owing to the very poor crop harvested in Krian, the most important *padi* area of the settlement and states. Considerable damage was recorded by stem borers in this same area, and work has been started on the possibility of controlling these insects by means of the breeding and liberations of the parasites, *Trichogramma* sp. The results of experiments conducted on the storage of rice so far indicate that, given adequate protection from insect pests, the crop can be stored in good condition for a period up to twelve months.

The oil palm industry continued to expand, the total area planted being 22,558 acres. Experimental work on the crop was continued and an experimental palm oil factory has been erected at the Department of Agriculture's Experiment Station.

PALM OIL IN NIGERIA.

FIG. 5.
Native apparatus. Filter and boiling pot.

FIG. 6.
Screw press (steel).

FIG. 7.
Screw press (wood and steel).

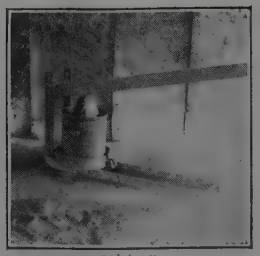


FIG. 8.
Lever type press.

FUSARIUM WILT DISEASE OF SUNN HEMP—II.

FIG. 1.

Plot area under Sunn Hemp, 1930. A "chess-board" appearance of wilted and healthy areas corresponding with positions occupied by Sunn Hemp and Pigeon Pea in the previous year.

FIG. 2.

A typical plot under Sunn Hemp in 1930, showing healthy and wilted halves.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Sugar-Cane Varieties.

During the last year or two, a number of new sugar-cane varieties have been introduced into the sugar islands of Antigua, St. Kitts and St. Lucia. These have been obtained from three main sources, viz., Barbados, Trinidad, and Guadeloupe. In Antigua the following varieties have been imported from Barbados: B. 417, B. 381, B. 606, B. 374, B. 726, and B. 891; from Trinidad: P.O.J. 36, 213, 234, 979, 2714, 2725 and 2878; and from Guadeloupe: G. 119, G. 140, and G. 153. In the agricultural notes prepared by the Agricultural Superintendent, Antigua, and published as a supplement to the Leeward Islands *Gazette* on the 22nd January, 1931, an account is given of these introductions. Many of the canes have been introduced quite recently, and it will be some time before sufficient material will be available for carrying out variety trials.

Most of the P.O.J. varieties are resistant to mosaic disease, and it is interesting to note that three new varieties resulting from crosses between P.O.J. 2725 and Sc. 12/4 and produced at the Mayaguez Experiment Station in Porto Rico, are also immune to mosaic. These crosses are also free from the early arrowing habit of P.O.J. 2725 which is making the latter cane unsuited to West Indian conditions. Two of these varieties, Mayaguez 7 and 42, are also drought resistant and compare well with Sc. 12/4 in this respect. They are of the "noble cane" type and germinate satisfactorily. Trials in Porto Rico reported on in *Agricultural Notes*, Porto Rico, for December, 1930, indicate that these three varieties Mayaguez 3, 7 and 42, are promising and worthy of trial by sugar planters.

* * *

Alkalizing Boiler Feed-Water with Soda Ash. *By J. F. Bogtstra.*

Recently one has heard it stated that the addition of soda to the boiler feed-water is injurious. Thus Claussen warns against the use of carbonate of soda on the ground that this decomposes into sodium hydroxide and carbon dioxide, which constitutents according to him attack the boiler plate. He would in its stead use the anti-incrustation preparation "Tartrizid" while the firm of Ruhaak & Co. also declares that soda should not be used, rather that their "Algor" should take its place (1). This question is now examined by the author. When soda ash is added to boilers, sodium hydroxide is formed, due according to Parr (2) to hydrolysis at higher temperatures, thus: $Na_2CO_3 + H_2O = 2NaOH + CO_2$. A Java sugar factory adds no more than 22 lb. of soda per 800 tons of feed-water in order to maintain the desired alkalinity. Assuming that soda ash is used, and that all the CO_2 from the carbonate passes into the steam, then one has to reckon with: $44/106 \times 10 = 4.15$ kg. or 9.2 lb. of CO_2 per 800 tons of feed-water, or say 5 mgrms. per kg. of steam. Further, according to numerous analyses reported by the Proefstation, there is also present in the united condensates of the first and second bodies of the evaporators at most 25 mgrms. of CO_2. Hence, in the steam one obtains at most 30 mgrms. per kg.; whereas, according to the standards of the German Boiler Proprietors' Association, 35 mgrms. are permissible. It is thus seen that, although such an addition of soda ash does not fall within the limit deemed to be harmful, yet for precaution's sake it is better to use caustic soda.

Now one comes to the second part of the question, namely, whether caustic soda is harmful to boiler-plate at high temperatures. Detailed investigations on this matter are reported by Heyn and Bauer (3), mostly, however, at room temperature showing a graph according to which the critical (maximum) concentration is at 0.1 and the threshold (minimum) at 1 grm. per litre. Regarding the effect of these concentrations at boiler temperatures, little is known. Bosshard and Pfenniger (4) state a minimum attack, at 15 grms. to 1 grm. per litre, the critical concentration not being indicated, though it must be between 0 and 0.1 grm. per litre. On these grounds, it appears right that the above-named Association should prescribe that the so-called sodium-number $\left(= \frac{Na_2CO_3}{4.5} + NaOH\right.$; in mgrms. per litre) of the boiler should be kept at 400 at least. In Java it is impossible to maintain so high an alkalinity, since the condensate used contains a fairly high content in organic matter. Priming would easily take place at such a high alkalinity, and one is therefore obliged to take the lower limit. Formerly the alkalinity of the boiler feed-water was held at 8.3 to 8.8 pH (determined at boiler temperature) corresponding to a sodium figure of 0 to 25. Now, on the advice of the P.S. this is raised to 10 pH, corresponding to a sodium-figure of 100 to 150, which lies closer to the German standard. Priming is then not to be feared. Referring to the literature, McAllep (5) considers a pH of from 8.3 to 8.8 sufficient, whilst Paris (6) and Stumper (7) approach to the new standard, viz., 0.2 grm. per litre. Summarizing, the present author considers that addition of caustic soda to 10 pH can only act favourably.—(*International Sugar Journal*, Vol. XXXIII, No. 388.)

1. In correspondence with the Java Proefstation.
2. *Bulletin Univ., Illinois*, No. 94, 1917.
3. *Mitt. Kon. Materialprufungsamt*, 1908, 26, 1.
4. *Chemiker Zeitung*, 1916, 42, 4, 46, 63 and 91.
5. *I.S.J.*, 1929, 44.
6. *Genie Civil*, 1923, 82, 392.
7. *Korrosion und Metallschutz*, 1928, 4, 227.

ERRATUM.

Biological Control: "Noxious Weeds."

On page 126 of Vol. VIII, No. 5, second column, line 38, *Clidemia* should read *Liothrips*.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Extraction of Papain.

A study of the procedure for obtaining papain from the fruit of papaya has been recently concluded by H. D. Sen (*Journ. Agric. Science*, XXI, 208). In India, the normal procedure is to lance the fruit longitudinally with a sharp knife. The incisions are only sufficiently deep to penetrate the skin. The exuding juice is collected in flat porcelain dishes, is filtered through fine muslin and then dried in the sun. The final proteolytic activity of the papain depends largely on the rapidity of drying. Artificial drying at a temperature not exceeding 35°C is sometimes used. The dry product is then ground and bottled. The yield is about 1 gm. per fruit. Experiments were conducted to determine the condition obtaining a maximum yield of juice of high activity.

It was found that successive lancings produced slowly diminishing yields of papain. After five daily lancings no appreciable yield was obtained from the fruits. The optimum number of lancings that could be made at one time was four, for although there was little change in the activity of the product with a greater number of incisions, the yield decreased appreciably. The maximum yield of highly active juice was obtained from full grown fruits which were not fully ripe. A plucked fruit did not exude juice.

A study of the different varieties of papaya showed that their fruits varied appreciably in their yield of papain. Soil conditions also affected the yield considerably. A plant grown on a shady, rich soil, yielded four times as much juice as a plant of the same variety grown on a poor soil exposed to sunshine. The difference in yield was due to a certain extent to the higher number of fruits occurring on the plant grown in good soil. An examination of the results, however, showed that the high yielding tree gave more papain per 100 gm. of fruit than the low yielding tree.

The study of the effect of soil conditions on yield was followed by an investigation of the effect of fertilisers. Various organic materials available in India were used. Castor oil cake and night soil had the most favourable effect. There were definite indications that potash starvation seriously affected the growth of papaya. Resistance to phosphate starvation was much higher.

* * *

Power Alcohol in South Africa.

The manufacture of industrial alcohol, methylated spirit, and ether from waste molasses was commenced in Natal about fifteen years ago. As the industry prospered, attention was paid to the manufacture of alcoholic motor spirit. The Natal Cane By-Products Ltd., produced a promising alcoholic fuel which they called "Natalite". It was found later that a better fuel resulted if "Natalite" was mixed with petrol, using ether as a mixing agent. Such a mixture, under the name of "Union Motor Spirit" has been used successfully throughout South Africa.

The company now projects the manufacture of absolute alcohol for use as a fuel. A new plant with a daily production of absolute alcohol of 2,000 gallons is being erected. It is hoped that in the near future by the use of its inexhaustible supplies of sugar, South Africa will be independent of imported petrol. At the same time, additional revenue derived from this by-product affords considerable assistance to the sugar industry.—(*The South African Journal*, Vol. XV, p. 23.)

* * *

The Recovery of Potash from Minerals.

Within recent months two methods for utilizing potash containing minerals, in particular, leucite, as a source of artificial potash fertiliser have been announced.

In Italy, Baron Blanc has developed a method by which leucite, a potassium alumino silicate, can be treated with acids to give at least three commercially valuable products. The potassium and aluminium are jointly separated from the silica as salts. A method has been developed by which these two metals can be separated as nitrates. The potash salts is valuable as artificial fertiliser. The aluminium salt is ignited under controlled conditions when a new type of chemically active aluminium oxide is produced. The oxide is very suitable for the manufacture of aluminium. The residual silica has high absorptive properties. The process has been started commercially to develop the large quantities of leucite which are available in Italy.

In America, chemists of the Bureau of Chemistry and Soils are experimenting along different lines to obtain potash from leucite. By heating leucite in an electric furnace at 1570°C. for forty minutes, more than a fourth of the potash in the mineral is volatilised. By mixing the leucite with calcium chloride and calcium carbonate volatilisation is increased. All the potash is volatilised below 1200°C. Other investigations have shown that if the leucite is mixed with phosphate rock and heated in a blast furnace, 90 per cent. of both potash and phosphate can be volatilised. A concentrated form of potassium phosphate may be obtained at an estimated cost of five pounds per ton. These processes are still in the experimental stage. Their commercial success appears to depend largely on being able to procure sufficient cheap heating power. Their success would make vast new sources of potash available. (*Nature*, Vol. CXXVII, p. 416; *Ind. Eng. Chem.*, Vol. XXIII, pp. 78 and 84.)

REVIEWS.

Flora of West Tropical Africa.

By J. Hutchinson, F.L.S., and J. M. Dalziel, M.D., B.Sc., F.L.S. Prepared at the Herbarium, Royal Botanical Gardens, Kew, under the supervision of the Director.

(Vol. II, Part I. Published by the *Crown Agents for the Colonies*, 4, Millbank, London, S.W.1. Price 8*s.* 6*d.*)

This section deals with the division *Metachlamydeae* of the Dicotyledons, a group which includes such cosmopolitan orders as the *Labiatae* and the *Compositae*, and also includes cohorts of mainly Tropical distribution, such as the *Apocynales and the Ebenales*.

The arrangement of the orders in this Flora, follows that of Hutchinson's "Families of Flowering Plants," which aims at presenting phylogenetic arrangement of the families of Dicotyledons. In this system, resemblances are emphasised rather than differences, thus families are associated which shew close general relationship. The groups (orders or cohorts) are smaller than those of the system of Engler and Prantl, and are arranged in sequences, which aim, as far as possible, to follow phylogenetic lines.

The regions included in the Flora are :—British West African Colonies, British Cameroons, the French and Portuguese Colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. The mountainous regions of the Cameroons and of Fernando Po contribute many genera, growing at elevations of between 7,000 and 12,000 feet, which are not otherwise present in a Tropical Flora. The species are often local ones; European species are rare.

The section contains nearly three hundred drawings of inflorescences and dissected flowers. They are very cleanly drawn, and are printed to a scale sufficient to shew useful detail.

E. E. P.

* * *

The Agricultural Situation in 1929-30.

Economic commentary on the International Yearbook of Agricultural Statistics for 1929-30. *International Institute of Agriculture*, Rome, pp. 174.

This is a study of the agricultural situation in 1929-30 based on the statistical data provided by the Yearbook. The subject is treated under the headings of the agricultural produce market, government measures for farm relief, the work of voluntary producers' organisations and the economic conditions of agriculture. Each of these themes is discussed in European countries, the British Dominions, U.S.A., India, Japan, and in some of the South American states. Although most tropical products are mentioned greater attention has been paid to the statistical position of agricultural products in the temperate regions. An attempt is made to explain the present agricultural crisis. The want of equilibrium between supply and demand is attributed to changes in production and consumption that have occurred during and since the War, and to the difficulty experienced by agriculture in adapting itself to post-war changes. Other features mentioned are increasing marketing difficulties, low prices and high production costs. Solutions to ease the situation are everywhere being sought in the improvement of marketing methods, in devising measures which will ensure greater price stability and in reducing production costs. Particular attention has been paid to the latter problem by stimulating research in farm accountancy and costings with the hope of evolving more remunerative systems of agricultural production.

The commentary, which concludes with an excellent bibliography, is not by any means comprehensive but should prove useful. It is hoped, however, that subsequent commentaries will contain more information about agricultural conditions in the tropics as this present volume is decidedly meagre in this respect.

G. G.

PLANT BREEDING ABSTRACTS.

The Imperial Bureau of Plant Genetics has begun to issue a publication entitled *Plant Breeding Abstracts* in which all the more important current publications dealing with plant breeding and the genetics of crop plants are listed. The references are classified according to subject and each reference is followed by an abstract indicating the subject matter of the paper and the results obtained. The papers are divided into two halves, those published in the British Empire and those published in foreign countries. Papers written in foreign languages are usually abstracted somewhat more fully than papers in English.

Plant Breeding Abstracts is issued quarterly and Vol. I, No. 3 which was published on 1st April, 1931, contains 197 references covering 52 pages.

The annual subscription for the publication is at present five shillings post free, single copies being obtainable at the price of one shilling and sixpence. Subscriptions should be sent to the Deputy Director, Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge, England.

BOOKS RECEIVED.

We have to acknowledge, with thanks, the receipt of the following books which have been presented to the Library :—

The Culture of the Orange and Allied Fruits, by H. Clark Powell, presented by the Publishers.

The Flora of West Tropical Africa, Vol. II, part I. by J. Hutchinson and J. M. Dalziel, presented by the Crown Agents for the Colonies.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.) :—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
30th April ..	6	3	10	0
7th May ..	6	0	9	9
14th May ..	6	3	10	0
21st May ..	6	1½	9	10½
28th May ..	6	0¾	9	10½
5th June ..	6	3	10	0
12th June ..	6	4½	10	1½

The outstanding feature since our last report has been the signing in Brussels of the Chadbourne Agreement by all the seven countries participating. The ratification of this agreement, which embraces the two largest Cane Sugar exporting countries of the world and the most important Beet Sugar exporting countries in Europe, makes an important milestone in the history of sugar. The final removal of any uncertainty which may have existed as to the ultimate ratification of the Scheme has no doubt contributed in large measure to the development of the present steadier feeling which has for some time been underlying the market. *Messrs. Czarnikow, Ltd.* report that the market has been somewhat disappointing, an improving tendency early in May which brought a slight improvement in value with an increase in the turnover of Raw Sugars, gave place later to an easier tone due to an unsettled Refined Market in America, while political troubles in Cuba exerted an adverse influence which has been reflected in the United Kingdom.

* * *

COCOA.—The market for the period under review has remained dull and values with slight fluctuations are again lower. Stocks in licensed warehouses in New York at 31st May were 1931 : 221,407 bags, 1930 : 289,361 bags, 1929 : 424,356 bags. In London on 16th May stocks totalled 224,503 bags against 195,151 bags for the corresponding period last year. It is evident that no improvement can be looked for until general trading conditions improve.—(*By Courtesy of the Cocoa Planters' Association of Trinidad.*)

* * *

COPRA.—Copra is easier for all descriptions, and the price of West Indian f.m.s. is 17*s.* 6*d.* per ton lower at £13 15*s.* buyers No. 2 contract terms c.i.f. London or Rotterdam.—(*West India Committee Circular*, 14th May.)

RUBBER—Quotations for Plantation Sheet have ranged as follows :—

	d.
29th April	2 1 3/16
6th May	2 1 5/16
13th May	3
20th May	3 1/8
27th May	3 1 1/16
5th June	3 1/8

At the beginning of May new low records in prices were created, Ribbed Smoked Sheet on the Spot selling at 2¾*d.* Since then the Market has hardened and prices advanced a ¼*d.* per lb. all round, the advance being caused in the main by American buying while some business was also done for the Home Trade and Continental Account. Generally speaking, report *Symington & Sinclair*, while the statistical situation has failed to show any real improvement, signs are not wanting that a continuance of a price below 4*d.* per lb. is likely to bring a marked reduction in outputs in the near future. A committee has been appointed by the Dutch Colonial Secretary to consider means to improve the rubber situation in the Dutch East Indies.

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association :—

	American Mid.	*Egyptian F.G.F. Sakel.*	*Sea Island.* *Good.*	*Extra fine.*	*Prices paid this Week.*
1st May	5·46	8·20	17·00	33·00	—
8th May	5·39	8·30	17·00	33·00	—
15th May	5·26	8·30	17·00	33·00	—
22nd May	5·12	—	17·00	33·00	—
29th May	4·80	—	17·00	33·00	—
5th June	4·78	—	17·00	33·00	—
12th June (local)	4·75	—	17·00	33·00	—

On 23rd May the price of American cotton in Liverpool broke its post war low record and further drops have occurred since. The decline in values during the last few weeks has been due to adverse conditions prevailing in the United States and the absence of any indication of increased world consumption. Recent weather reports indicate on the whole that climatic conditions are not very favourable as heavy rains have recently taken place in many parts of the American belt and crop progress has been hindered by low temperatures.

* * *

BANANAS.—Jamaicas have been in fair demand, with an improving tendency in the past few days. Prices are unchanged to wholesalers at £20 15*s.* per ton delivered London, and £20 10*s.* nearest railway station ; retailers continue to pay about 10*d.* per dozen. Brazilians are also unchanged at £18 delivered nearest railway station, and in good demand. — (*West India Committee Circular*, 14th May.)

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

COLLEGE NEWS BULLETIN

JULY, 1931] [No. 3

COLLEGE NEWS.

Mr. E. M. Cook of the Gold Coast Department of Agriculture, who has taken a refresher course at the College, sailed for England by s.s. *Coronado* on 18th May.

* * *

Mr. G. A. Jones, Assistant Commissioner of Agriculture, who sailed for a visit to the Leeward Islands and St. Lucia on 6th April by s.s. *Lady Drake*, returned to Trinidad by s.s. *Lady Nelson* on 26th May.

* * *

A meeting of the Trinidad Science Club was held on 30th April when Mr. M. C. M. Bridges, Ex-Inspector of Produce, Department of Agriculture, Nigeria, read an interesting paper on " Produce Inspection in Nigeria."

* * *

Mr. H. A. Ballou, Professor of Zoology and Entomology and Commissioner of Agriculture, and Mrs. Ballou, sailed for England by s.s. *Bayano* on 15th June. Mr. H. H. Croucher, Lecturer in Chemistry, and Mrs. Croucher, and twenty-eight students sailed by the same opportunity. Professor Ballou will be relieved of his duties as Acting Principal by Mr. E. E. Cheesman, Professor of Botany and Genetics.

* * *

Mr. C. Y. Shephard, Professor of Economics, left Trinidad on 7th April by s.s. *Lady Drake* for Grenada where, at the request of the Government of that Island, he investigated the possibility of conducting an economic survey of its cacao industry. Professor Shephard returned by s.s. *Lady Nelson* on the 13th April, and his Report on the visit has been submitted to the Government concerned.

* * *

Recent visitors to the College include: Messrs. C. B. Doyle, J. S. Townsend, R. L. Taylor, Washington, cotton experts representing the U. S. Department of Agriculture; Capt. A. Demorest, American Vice-Consul in charge of Interests of China, Trinidad; Mr. O. R. Nelson, Jnr., Secretary to the American Vice-Consul, Trinidad; Mr. R. L. Montgomery, M.R.C.V.S., Veterinary Adviser to the Colonial Office, London; Dr. P. Ling, Chinese Legation, Havana, Cuba; and Mr. B. Philipps, Salisbury, England.

The following members of the College have proceeded on leave: Mr. G. Evans, Principal, and Mrs. Evans, sailed for England by s.s. *Bayano* on 27th March; Mr. R. C. Wood, Professor of Agriculture, and Miss Wood, by s.s. *Costa Rica* on 20th April; Dr. H. R. Briton-Jones and Mrs. Briton-Jones by s.s. *Camito* on 20th April; Mr. C. Y. Shephard, Professor of Economics, and Mrs. Shephard, by s.s. *Bayano* on 3rd May; Mr. R. E. Hunter, Lecturer in Botany and Genetics, Mrs. Hunter and Dr. Mary V. F. Beattie by s.s. *Coronado* on 18th May; Mr. F. Hardy, Professor of Chemistry and Soil Science, Mrs. Hardy and child, by s.s. *Camito* on 1st June.

* * *

In extension of the soil work which forms part of the College Cacao Research Scheme, a fortnight's visit was paid by Professor Hardy and Mr. J. A. McDonald, to Grenada during April, 1931. Through the kind co-operation of the Trinidad Department of Agriculture, excellent preparations had been made for the examination and soil sampling of some thirty-five profile pits and numerous road sections, the site of which had previously been selected by Mr. R. O. Williams, in consultation with Mr. J. de Verteuil. The thanks of the College are due to the Trinidad Department of Agriculture for this aid, and to the planters of Grenada for their generous hospitality. A special report on the results of this work and of the laboratory examination of the collected soil samples, will be issued before the end of the year.

* * *

Dr. and Mrs. Myers who spent most of the earlier part of this year in the forests of the Delta of the Orinoco and of the North-West District of British Guiana studying cane borers and Froghoppers, returned to Trinidad towards the end of March with a consignment of a very promising parasite of the giant moth borer (*Castnia*). Mr. H. E. Box who has been appointed by the Colonial Office on a grant from the Colonial Development fund to make an intensive ecological study of the small moth borer (*Diatraea*) in Antigua, and Mr. L. D. Cleare who has been given a similar appointment, arrived in Trinidad at the same time. The work of both these entomologists is, for purposes of co-ordination, to be under the general technical direction of Dr. Myers. The time which they were able to spend in Trinidad, thanks to the courtesies

extended by the Colonial Office and the British Guiana Government, afforded a good opportunity to discuss plans for co-ordinated research, and an excellent basis of agreement was established.

At the beginning of April D . Myers proceeded to Antigua with Mr. Box who made several discoveries of the greatest interest in the islands *en route*, while Mrs. Myers remained in Trinidad in charge of the rearing of the *Castnia* parasites. Dr. Myers spent some time in Antigua discussing Mr. Box's problems on the spot and on his way back to Trinidad stayed four days in St. Lucia.

On 31st May Dr. Myers flew by the Pan American Air Mail to Haiti where he will organise the collection of root borer (*Diaprepes*) parasites for introduction into Barbados, where they will be handled by Mr. R. W. E. Tucker, Government Entomologist. The preliminary studies of this parasite were made in Haiti on a previous journey. Dr. Myers also hopes to spend a few days in Porto Rico to make comparative observations on pests of cane, bananas, coffee and sweet potatoes. Mrs. Myers accompanied her husband as far as St. Lucia where she will spend a holiday to recuperate from a recent illness.

ANNUAL COLLEGE DINNER.

A most successful evening was held on 14th March when the Students entertained the Staff to dinner in the Milner Hostel. The toast of the Principal, Staff and College was proposed by Mr. J. N. Clothier and seconded by Mr. M. C. M. Bridges, and replies suitable to the occasion were made by the Principal and Professor Ballou. All these speeches and others were heartily applauded. Mr. Bridges' brilliant epigrams invented on the spot concerning members of the Staff were greatly appreciated and the following gem should certainly not fail to be handed down to posterity.

Professor Ballou is regarded with awe
By insects that puncture, or nibble or gnaw,
When the larvae get peevish, as all children do,
They subside when their Mothers just whisper
" Ballou " !

MARRIAGES.

Mr. G. G. Gianetti, Editor of *Tropical Agriculture* and Librarian at the Imperial College of Tropical Agriculture, and Dr. Mary V. F. Beattie of the London School of Hygiene and Tropical Medicine, were married at St. Augustine on 7th April.

* * *

Mr. W. H. Beckett, Superintendent of Agriculture, Gold Coast, who was taking a refresher Course at the Imperial College of Tropical Agriculture, and Miss Rosalie de Boehmler, were married in San Fernando on 13th June.

We take the opportunity of extending our heartiest congratulations and best wishes to both couples.

EASTER VACATION TOUR.

[*The account appearing below was prepared with the help of notes kindly supplied by Messrs. J. M. King and J. D. Jameson, Post-Graduate students.*]

As has been customary in past years a party of Post-Graduate students, accompanied by Dr. H. R. Briton-Jones, Professor E. E. Cheesman and Mr. D. H. Brown proceeded on a tour of the Windward Islands during the Easter vacation, sailing by the s.s. *Lady Drake* on 6th April and returning by the s.s. *Lady Nelson* on 14th April, 1931. The Colonial Office Cadets, after paying brief calls in Grenada and St. Vincent spent three days in Barbados and two days in St. Lucia. The Cotton students, on th other hand, remained in St. Vincent for six days.

In Grenada an opportunity was given to observe cacao grown without shade and under intensive methods of cultivation. A very favourable mpression was obtained of the general state of the cacao and nutmeg plantations. High cacao yields per acre are secured by making a practice of burying all trash, leaves and broken pods into the ground and by trenching.

In Barbados the party after being received by the Director of Agriculture and Dr. McIntosh went first to Broome Hall where the gumming disease of sugar-cane is being studied and where experiments are also being conducted, to discover the most profitable planting distance for canes. Gumming disease is not at present of economic importance as it has not yet been known to reach a virulent stage of development in the Colony. It is being studied carefully, however, in anticipation of the possibility of its developing this stage and because B11569, which is the staple cane grown in Barbados, is highly susceptible to the disease. A syrup factory was inspected and the old windmill was seen. At this factory a clear syrup with a characteristic molasses flavour is being manufactured and the members of the party were given the opportunity of tasting the product in half pint glasses. At the Headquarters of the Department of Science and Agriculture, Mr. Tucker, the Government Entomologist, demonstrated his experiments on the biological control of the sugar-cane moth-borer. Much interest was shown in the cane breeding station where the possibilities of new cane varieties are being tested for the cropping and rainfall conditions existing in the Colony.

In St. Lucia visits under the direction of Mr. E. A. Walters, Superintendent of Agriculture, were paid to the Union Experiment Station, the Cul de Sac valley, a grape fruit plantation and a lime factory at Marquis Estate. Much propagation work is being done at the Union Station and guaranteed stocks and seedlings (citrus, pineapple, avocado pear) are being reared. The station also maintains a quarantine department for imported plant material. Pigeon peas are grown under coconuts as a demonstration

mulch crop, the practice followed being to let this cover crop grow to six feet and then to cut it back to three. A plot of Blue Mountain coffee seedlings and of dwarf coconuts was seen and a new method for propagating pineapples demonstrated. A good deal of work is being done at this station on the avocado pear with a view to exporting a good standardized durable type of fruit.

In St. Vincent the party was throughout its stay in charge of Mr. Jackson, Superintendent of Agriculture. Just after landing it inspected the Government Fruit Depôt in Kingstown, and witnessed the packing of tomatoes and onions for shipment to Canada on the s.s. *Lady Drake*. The next day, Wednesday, although it rained copiously the party drove up the windward coast and lunched at the edge of the Dry River beyond Georgetown. After taking shelter in the Soda Water, Ice and Rum Factory near Greathead Bay, it proceeded to the Arrowroot Works at Sans Souci; saw the sorting of superfine quality cotton at Grand Sable and the Rum still at Mount Bentinck. Coming back, a detour was made through the Mesopotamia Valley with its wonderful scenery to return just in time for the Garden Party at Government House. On Thursday, guided by Mr. Evelyn, the Cotton Station and Government Ginnery were visited. On Friday, the Leeward Coast road was followed as far as possible even to the extent of shoving the cars, and the party saw the arrangements made for grafting peasant's mangoes in the Clare Valley; an old Musa textilis plantation at Bellisle; and a great deal of cotton being picked, sorted and ginned at Wallilabou and Peter's Hope. Saturday was spent at the Government Dairy in the Botanic Gardens and in fulfilling the invitations of as many hosts and hostesses as was humanely possible. As a result, possibly only three climbers, of which Professor Cheesman was one, tackled the Soufriere on Sunday morning. Luckily the crater was perfectly clear and some excellent photographs were obtained. The whole party was entertained to tea at the Orange Hill Coconut Estate by Mr. and Mrs. Child. The three feet of cinders from the 1902 eruption of the Soufriere was a truly remarkable demonstration of a mechanical mulch and had produced some very fine coconuts.

This year's tour, as previous ones, proved very successful, and we should like to record our thanks to His Excellency, Sir Thomas vans Best and Mrs. Best, and to all other ladies and gentlemen for their delightful hospitality and kindness and for the excellent arrangements which they provided to make our stay such a pleasant and profitable one.

G. G.

Copies of *College News Bulletin* may be had on application to the Editor, *Tropical Agriculture*, St. Augustine, Trinidad, B.W.I. Price, 6*d*. each or 2*s*. per annum.

Mr. D. H. BROWN.

Mr. D. H. Brown, who was seconded for two years from Nigeria as Second Agriculturist at the College, sailed on 15th June by s.s. *Bayano* for England, where he will proceed on leave prior to resuming his activities with the Nigerian Department of Agriculture.

During his term of office Mr. Brown won our respect by the able manner in which he carried out his duties. He not only assisted in the teaching work of his Department but also supervised much of the work on the College Farm. His investigations in Trinidad were mainly confined to yams and an abstract of a thesis which he has prepared on this crop will be published shortly in *Tropical Agriculture*.

Mr. Brown also distinguished himself in the field of sport and was a regular member of the College Rugby XV. He was a popular figure amongst us and the many friends whom he made in Trinidad will be sorry to lose him.

The very best wishes of the staff and students go with him in his new field of work.

THE COLLEGE SUGAR FACTORY.

The grinding operations which began on the 11th March, ceased on the 24th April, 1931, with results which compare as follows with the previous year:—

	1931	1930
Tons of cane ground	857.58	503.09
Hours of grinding	303.03	180.17
Tons of cane per hour	2.83	2.79
Cane :— Pol. per cent.	13.77	13.91
Cane :—Fibre per cent.	13.43	13.18
Normal Juice :—Brix.	19.12	19.18
Normal Juice :—Purity	82.95	85.14
Tons cane/tons sugar	10.18	9.12

One hundred tons of cane were ground in excess of the estimate, the cane being supplied from the Government Farm and the College plots. The Third Year Diploma Students were put in charge of the Analysis and the Reports and the Fourth Year students in charge of the factory operations, the cane supply and sugar shipments. The sugar was produced in the form of yellow crystal (33.83 tons), Raw Sugar, (32.32 tons), Molasses Sugar (10.76 tons) and Fancy Molasses (7.26 tons). There was not much difference in the cane analysis figures but the juice purity was slightly lower. The machinery worked satisfactorily.

SUPPLEMENTS.

The following Supplements to the Journal can be obtained on application to the Editor:

1927 Sugar Supplement ..		1*s*.
Sugar Cost Accounts	..G. C. Skinner	1*s*.
Wilt Diseases of Coconut Palms.—(Parts I and II)	H. R. Briton-Jones	6*d*. each.
Giant Moth Borer of Sugar-Cane.. ..	..H. Martyn Skinner	6*d*.

OLD STUDENTS' CORNER.

J. D. Broatch (1927-28) is now stationed at the Training Centre, Kumasi Gold Coast.

* * *

C. W. L. Fishlock (1928-29), A. S. Thomas (1928-29), and J. Wright (1928-29), of the Department of Agriculture, Gold Coast, are all proceeding on leave this year.

* * *

W. T. O. Maidment (1924-25) has left the Gold Coast to join the Staff of the Uganda Department of Agriculture.

* * *

O. J. Voelcker (1927-28) is now stationed at Ibadan, Nigeria, where he is specialising in plant breeding work.

* * *

J. F. Williams, Diploma Student (1927-31) has been appointed Assistant Chemist to Messrs. Brooker Brothers, McConnell & Co., Ltd., British Guiana, in connection with a soil survey which this Company is carrying out on their estates.

* * *

R. J. A. W. Lever (1929-30) has been appointed Entomologist to the Solomon Islands. Prior to taking up his appointment he spent some time in Fiji where he studied a coconut pest, the Hispid beetle (*Promecotheca reichi*). He expects to remain at Tulagi, in the Solomon Islands for the next four and a half years. He had a very pleasant trip on the *Mauretania* to New York and then on to Fiji *via* Honolulu. He says he thoroughly enjoys his work but expects to be very much alone when he reaches his final destination.

* * *

F. B. Notley (1929-30) who is at Sotish in the Nyanza Province of Kenya, says that this is one of the pleasantest parts of the Colony. It is situated at about 7,000 feet. Its only drawback is that as far as "coffee shambas" are concerned it is one of the most remote, being about 80 miles from the railway and surrounded by native reserves. It is very much colder than Trinidad, fires at night being a necessity. His work is entirely confined to coffee and is very interesting especially as conditions seem to change entirely in each district. He mentions an amusing episode at the beginning of his career as Entomologist when he was asked by a "fierce looking woman in trousers and a very torn shirt" the depth necessary for the decent burial of a dead native.

Query: Was it her husband?

* * *

S. T. Hoyle (1929-30) who is in Nyasaland spent the first six weeks after his arrival touring the Colony. During this tour he met with a bad storm, something approaching a cloud burst which broke the steering gear of his car and forced him to spend the night where he was. He tells us that he is opening up a new experimental farm at Zhitala (P. O. Dowa). He is enjoying his work which he finds very interesting. Half of the proposed area of the farm has been cleared so far and he will have to build his own house. He mentions that there is plenty of big game in his district.

* * *

N. R. Fuggles (1929-30) writes very cheerfully from Morogoro, Tanganiyka Territory. He mentions that G. W. Lock (1929-30), after staying a couple of months at Kilwa, has joined Headquarters and that they both are likely to share the same house. Lock is carrying out an economic survey of the sisal crop while Fuggles is helping to design experiments on the experimental farm and supervises the distribution of cotton seed and of uprooting and burning campaigns. The station which is situated in an important sisal and cotton area, is a large one. The town lies at the foot of magnificent mountains. The climate is very good. The natives plant a good deal of cotton but owing to poor prices and a famine this year larger areas have been put under food crops.

Printed by the Government Printer.